Harrison Science Research Presents:

The 22nd Annual

HARRISON HIGH SCHOOL SCIENCE AND TECHNOLOGY SYMPOSIUM

Monday, June 3, 2024
7:00 PM - 9:00 PM
HHS Student Union

Scientific presentations of original research, engineering, and design projects by Harrison High School Students

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:

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Allison Blunt

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Dr. Brian Ladewig, Ed.D.
Dr. Joan O'Keeffe, Ed.D.
Ms. Kim Beukema, Principal

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

Order of Events

6:30-7:00 **Science Research Orientation for 9th Grade (& other 1st Year Parents)**

7:00-7:15 **Open House & Refreshments in the Student Union**

- Students & Parents are invited to informally visit posters.

7:15-8:00 **Poster Presentation Session in the Student Union**

- This session will include students from the Science Research and Technology Education programs. 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.

8:00-9:00 **Program Honoring the Work of Our Students**

- **Montage** - The Year in Photos
- **Retirement Celebration** for Dr. Joan O'Keeffe, Director of Technology
- **Opening remarks** - Dr. Joan O'Keeffe, Director of Science & Technology Education
- **Highlights of the HHS Program** - Allison Blunt
- **Guest Presenter** - Melissa Yanez, HHS SR Alumnus and Senior Research Assistant, Weill Cornell Medicine, Division of General Internal Medicine
- **Project Presentation** - Alec Udell
- **Senior Reflections**
- **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

Congratulations

Dr. Joan O'Keeffe

Director of Science

HAPPY RETIREMENT!

Science Research Seniors

Galle Blaustein

Characterization of MET Downstream Signaling Pathways Required for Uveal Melanoma or NSCLC Cell Migration/Invasion

Location of Research:
Regeneron Pharmaceuticals

Mentor:
Dr. John DaSilva and Oliver Surriga

WIll be Attending:
Amherst College

Intended Major:
Biology

Fairs & Awards:
WESEF 2024-4th Place, Cell & Molecular Biology
JSHS 2024 -2nd Place, Cell & Molecular Biology
WESEF 2023-3rd place,Cell & Molecular Biology, STANYS finalist
Somers 2022-1st Place, Cell & Molecular Biology
HHS Science Symposium- 2022,2023,2024

Metastatic cancer is when cancer has spread from its site of origin to various sites with poor prognosis in cancer patients. Abnormal pathways in the body drive progression of metastasis. Metastasis activity for Uveal Melanoma (UM) and Non-Small Cell Lung Cancer (NSCLC) is propagated by the Mesenchymal Epithelial Transition Factor (MET) receptor its ligand, Hepatocyte Growth Factor (HGF). Following ligand binding, the kinase activity of MET gets activated by receptor dimerization that recruits downstream signaling pathways in the MET cascade. Previous research indicated UM cell invasion/migration is activated with HGF inhibited by the MET tyrosine kinase inhibitor, Capmatinib. The characterization of the MET signals that led to UM cell migration/invasion needed to be elucidated. Furthermore, EBC1 MET amplified NSCLC cell lines are prone to resistance from treatments. The role of Capmatinib treatment in EBC1 cell lines of NSCLC needs to be elucidated. The methodology consisted of two parts. The first part was Western blotting and Phospho-kinase proteome profiling to characterize signals expressed in UM cell lines MP41 and OMM1.3 with treatment of Capmatinib and HGF. The second assay consisted of an invasion assay determining Capmatinib and HGF effects invasion of EBC1 cells. The results indicated various signals along the MET in UM cell lines linking their various roles in metastatic potential. However, the invasion assay proposes that HGF stimulation and by Capmatinib had little to no effect on EBC-1 invasion. Further steps are needed to explore combinatorial pathway inhibition approaches to block metastasis of UM and NSCLC cells.

Characterization of MET Downstream Signaling Pathways Required for Uveal Melanoma or NSCLC Cell Migration/Invasion

Introduction

Metastatic is cancer that has spread from its site of origin to various sites

Increased propagation by signaling pathways such as **MET**

Dimerization of HGF and MET leads to recruitment of **signaling effectors**

Lead to **metastatic progression** of **UM and NSCLC**

UM and NSCLC metastasis = inhibited by **Capmatinib**

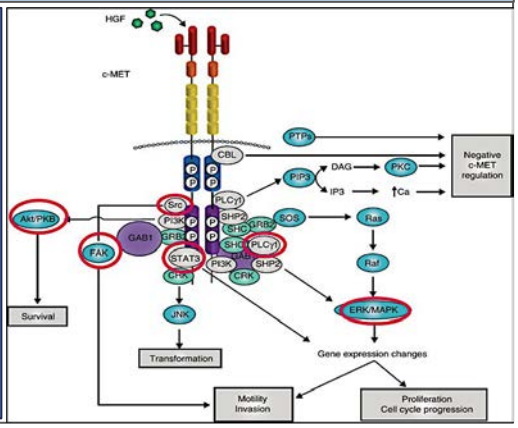
2022 study shows UM metastasis=inhibited with Capmatinib

The Mechanism of MET signaling in UM needs to be elucidated

EBC-1 NSCLC cell line shown to have **MET gene amplification** that drives **ligand-independent signaling**

Gap in Knowledge

Understanding of MET signaling pathways driving metastasis in UM and EBC-1 NSCLC with capmatinib inhibitions

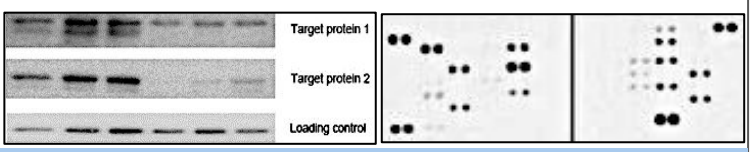


Methodology

Western Blot + Phospho-kinase proteome profiler array:

Detect protein expression in MET cell signaling pathways in UM cell lines

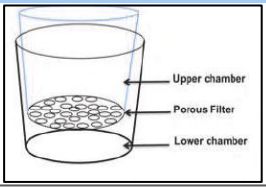
Western Blot	Phosphokinase array



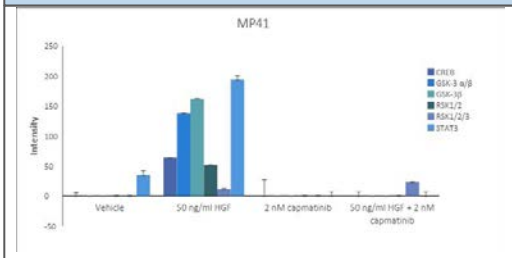
Boyden Chamber Assay:

Detect EBC-1 NSCLC cell lines invasion

2 and 4 nM Capmatinib

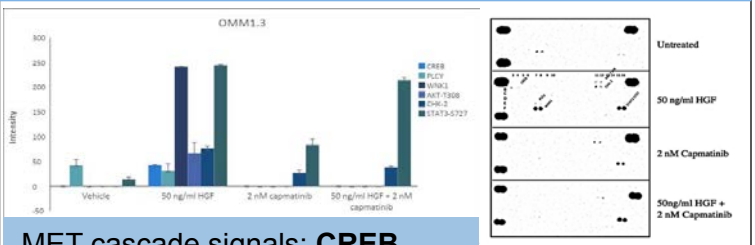


Results & Analysis



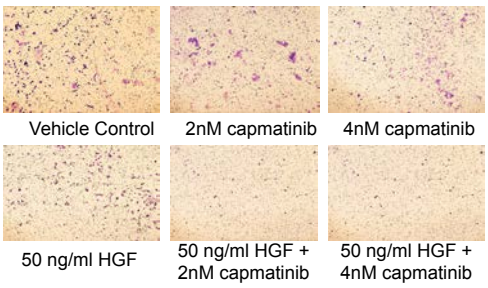
MET cascade signals: **CREB, GSK-3β, GSK-3a/ β, RSK1/2, RSK1/2/3 and STAT3**

ImageJ of MET signals in UM



MET cascade signals: **CREB, PLCY, WNK1, AKT-T308, and CHK-2**

ImageJ of MET signals in UM



Constitutive activation of MET pathway in EBC1 cells not increased by HGF

Conclusion & Future Research

✓ Characterization of MET cascade signals in UM

-Several kinases downstream of MET-Implicated in UM **proliferation, survival and motility**

There is resistance of EBC1 Cell Lines To Treatment

X There is resistance of EBC1 Cell Lines To Treatment

EBC1 invasion was inhibited by CAP but was not significantly altered by ligand stimulation of HGF

Future Research

Discovery of other inhibitors implicated in cell invasion

Implications

Understand the role of key MET Sites across cancer types and discern the role of key metastatic inhibitors

Julia Carrea

Movies Synchronize Eye Movements and EEG Signals: A Study to Analyze the Effect of Attractiveness and Familiarity on Attention Allocation and Intersubject Correlation

Location of Research:
Harrison High School and Parra Lab

Mentor:
Dr. Jens Madsen, CUNY

Will be Attending:
Cornell University

Intended Major:
Biological Sciences

Fairs & Awards:
WESEF 2024 - 4th Place Behavioral & Social Sciences
JSHS 2024 - Regional Speaker
WESEF 2023 - 4th Place Medicine & Health
NYSSEF 2023 - Honorable Mention Medicine & Health
Somers 2022 - Participant
HHS Symposium - 2022, 2023, 2024

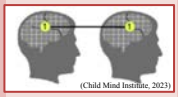
Movies are a storytelling medium used to communicate messages, with $6.54 billion spent each year. Therefore, it is crucial to understand what captures audiences' attention to more effectively engage audiences. Attention is the ability to selectively concentrate on an aspect of information. Two factors that may influence attention during movie watching are familiarity and attractiveness. Familiarity refers to one's ability to recognize an actor/actress and attractiveness refers to the level of physical appeal of an actor/actress. If these factors increase attention, it would be beneficial to include them more often in movies. One method of quantifying attention is to examine the Intersubject Correlation (ISC) of eye movements recorded through eye-tracking technology (pupil size and gaze point) and EEG signals (electrical activity of the brain). ISC is a measure that provides a summary of synchrony among subjects over time and can be interpreted as attention level. The purpose of this study was to determine relationships between eye movement (pupil size and gaze) and EEG ISC, character scene presence, and factors (attractiveness and familiarity) that may influence attention during movie watching. Results found through statistical interactions demonstrate that regardless of examining attention through ISC of pupil size, gaze, or EEG, there was a greater ISC difference between those who rated their attractiveness high vs. low in scenes where that actor/actress was present. This means that there was a stronger influence of attractiveness when the actor/actress that participants found attractive is present ($p>0.05$). These trends were also found when examining familiarity. Additionally, greater familiarity and attractiveness ratings led to increased attention throughout the movie ($p>0.05$). These findings may be useful in the movie industry, as including familiar and attractive actors/actresses may allow for messages to be more effectively conveyed, increasing movie sales.

Movies Synchronize Eye Movements and EEG Signals: A Study to Analyze the Effect of Attractiveness and Familiarity on Attention Allocation and Intersubject Correlation

Introduction

Movie Watching	Attention	Factors
$6.54 billion in U.S. (Statistica, 2022) Storytelling medium	Concentrating on information	Familiarity: Ability to recognize
	Gain attention	Attractiveness: Physical appeal
What captures attention?	Actively engage in message	Factors ↑ attention= include in movies

Quantifying Attention

Gaze Point:	Pupil Size:
Point where eye is looking	Dilated= pupil widens
Electroencephalogram (EEG):	**Intersubject Correlation (ISC):**
Detect brain electrical activity  (Simply Psychology, 2023)	Similarity between behavior  (Child Mind Institute, 2023)

Madsen et al. (2020)

Greater eye movement ISC= ↑ attention → Greater ISC/attention= ↑ understanding of content

Purpose: Determine relationships between **eye movement** and **EEG ISC**, **character scene presence**, and **attention factors** during movie watching

Methodology

Variables

Independent	Dependent	Controlled
Character Scene Presence	Eye Movement & EEG Signal ISC	Movie
 (CharacTour, 2015) (Pittsburgh Post-Gazette, 2015) (Tubi, 2015) (Tubi Films, 2019)	 (Tobii, 2021)	 (IMDB, 2015) Selected due to: → Serious themes
Familiarity & Attractiveness		Environment= Lab Setting
Collected using questionnaire	Collected during movie watching	

Student & Mentor Roles

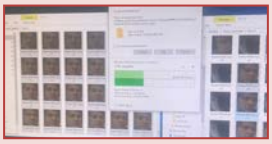
Background research → Formulate question → Correct AI algorithm → Determine analyses → Analyze data

Mentor provided student with de-identified dataset

Participants

Female #	Female Ages	Male #	Male Ages
9	18-26	12	20-37

Character Presence

 (Cerna, 2023)

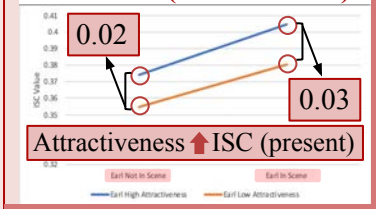
Algorithm= API from Hume.AI

Corrected files → scene presence

Results & Analysis

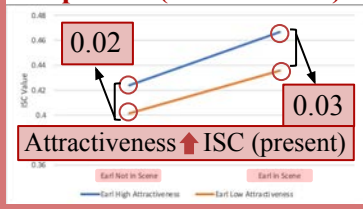
Attractiveness Interactions

Gaze ISC (Character #2)



Attractiveness ↑ ISC (present)

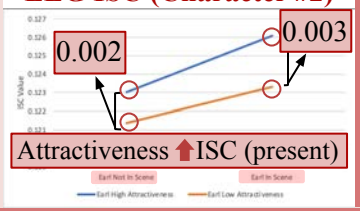
Pupil ISC (Character #2)



Attractiveness ↑ ISC (present)

Attractiveness Continued

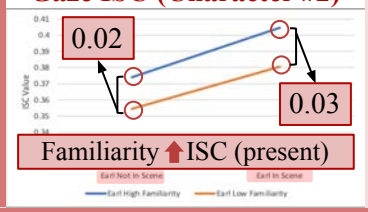
EEG ISC (Character #2)



Attractiveness ↑ ISC (present)

Familiarity Interactions

Gaze ISC (Character #2)



Familiarity ↑ ISC (present)

Familiarity Continued

Pupil ISC (Character #2)

Familiarity ↑ ISC (present)

EEG ISC (Character #2)

Familiarity ↑ ISC (present)

Conclusion & Future Research

ISC values of eye movements & EEG signals= measure of attention

Attractiveness & Familiarity → all ISC differences= when character is present, attractiveness and familiarity have ↑ influence on ISC (not significant)

Greater familiarity & attractiveness **ratings**= ↑ attention throughout the movie

↓

Especially when attractive/familiar characters are **present**

Other Ways to Measure Attention

Fixation time→ time spent looking at characters

Average area of fixations→ focused on characters?

Film industry may benefit from hiring attractive/familiar actors/actresses

↑ Attractiveness & familiarity= ↑ attention/ISC

↑ Attention/ISC= ↑ **understanding** of messages

Allows for **full potential** of movies to be **met→ more effective** storytelling medium

Increase movie sales $$$ →  (KTLA, 2019)

Mia Castillo

Determining the Most Efficient Shape of a 3D Printed Solar Evaporator Structure to Maximize Clean Water Production

Location of Research:
Harrison High School

Mentor:
Mr. Michael Schweitzer, Harrison High School
Dr. Christopher Cadou, University of Maryland

WIll be Attending:
Drexel University

Intended Major:
Engineering - Undecided

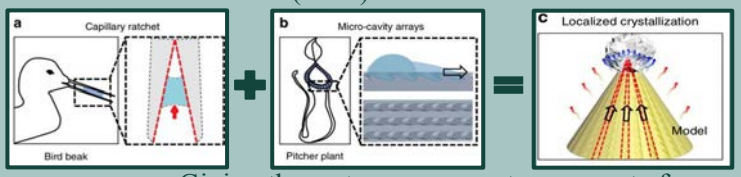
Fairs & Awards:
WESEF 2024 - David M. Holmes WESEF Engineering Innovation Award: Mr. Holmes
Regeneron STS - 2024 participant
HHS Symposium - 2022, 2023, 2024

Earth's surface is roughly 70% water; only 1.6% is obtainable and drinkable. In developing countries, water scarcity is an immense concern. Although modern water purification methods are available, they can be inefficient and harmful to the environment. Solar evaporation is a sustainable method that uses renewable energy but is also ineffective. A study by Wu (2020) found that using biomimetic cones increased the evaporation rate and localized crystallization to increase the efficiency of a solar evaporator. To ensure that the cone was the best shape, four geometric shapes (Cone, pyramid, tetrahedron, and hemisphere) were designed using the OnShape software and printed using a Form3+ 3D printer. The shapes are all made using standard black draft resin. These shapes were purposely constructed with little ridges to increase the surface tension. The ridges' purpose is to allow water to travel up the shape utilizing the Marangoni effect, which is the mass transfer along two surfaces. This process gives the water more area to evaporate off. Each shape was assigned its container, lamp, and petri dish- which held 100ml of 300 ppt artificial seawater. The containers were then placed directly 42cm under the 250-watt heat lamp. After 24 hours, the weight difference of the entire container, glass dish, and tupperware was calculated. To standardize the results, the evaporation rate per unit of surface area was calculated by finding the evaporation rate for each shape, then divided by the shapes surface area. The results state the pyramid significantly evaporated the most water with a rate of .06 ml/hr per unit of surface area..

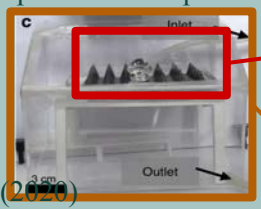
Determining the Most Efficient Shape of a 3D Printed Solar Evaporator Structure to Maximize Clean Water Production

Introduction

- 71% of earth is made of water
  - Oceans cover 97%
  - Obtainable drinking water .6%
- How to increase efficiency of a solar evaporator?
  - Wu et al. (2020)



  - Giving the water more area to evaporate from will increase evaporation time
- The ridges on the biomimetic cone were to maximize capillary action (adhesion & cohesion forces)
- Marangoni effect → gradient of surface tension along the interface between two phases
  - As the water heats up it will travel along the surface of the cones sides.
- Wu placed the shapes in a two tiered solar evaporator



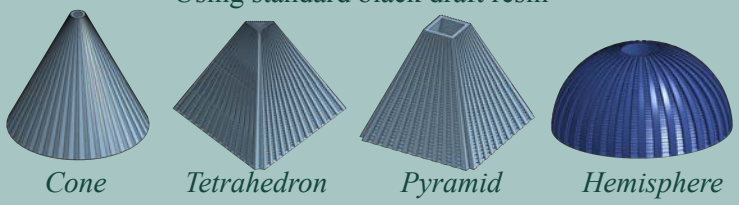
Small container with shapes & salt water

Large Container holding small container & collection water

Wu et al. (2020)

Methodology

- Form 3+ 3D Printer, FormLabs (2023)
  - Using standard black draft resin



Cone *Tetrahedron* *Pyramid* *Hemisphere*

Apparatus setup

Castillo, (2023)

1st: Weigh parts
- Smallest container to largest

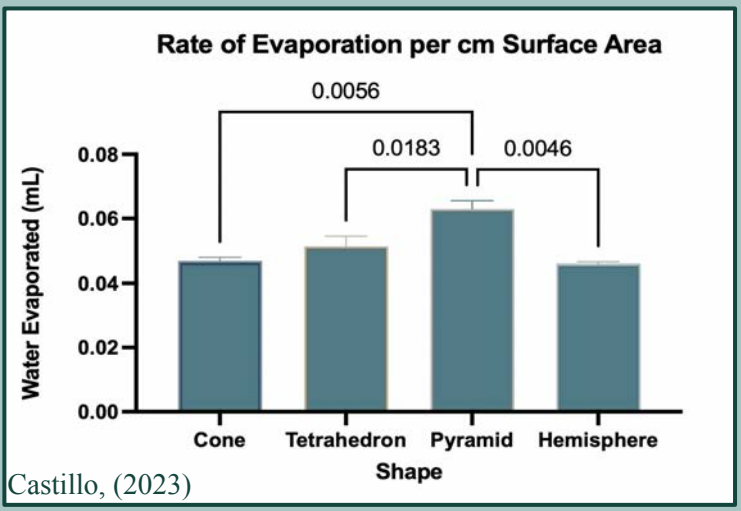
2nd: Leave under lamp (24 hours)

3rd: Place in ice bath
- Condense heat vapor

4th: Weigh parts
- Largest container to smallest

Results & Analysis

Evaporation Rate	Evaporation rate per unit SA
$\frac{\text{Water left in tupperware (mL)}}{\text{Twenty four (Hr)}}$	$\frac{\text{Evaporation Rate (mL/Hr)}}{\text{Surface Area (cm}^2\text{)}}$



Castillo, (2023)

Fig 1. The pyramid had a significant higher evaporation rate per cm^2 relative to the other shapes.

Conclusion & Future Research

- How many shapes will it take to produce recommended amount of drinking water?
  - Recommended water daily intake for an adult→ 3 liters = 3000 mL
- Number of shapes needed to produce recommended daily intake within 24 hours

$$\left[\frac{3{,}000\ (\text{mL})}{[\text{Evaporation rate per cm}^2\text{ of 'X' shape}][24\ (\text{hr})]}\right]$$

- The amount of surface area needed from the shapes to evaporate recommended amount

Hemisphere	Tetrahedron	Pyramid	Cone
2716.99	2435.58	1983.60	2669.04

- It will require less surface area of the pyramid to evaporate 3 liters of water.
  - Approximately 40 pyramids.
- The shapes will be placed on a grid to create an apparatus as a table. Area of table for the pyramid (diameter = 5.7cm):
  - 40 pyramids = 5(5.7) + 8(5.7) = 1299.6 cm^2

Mason Danzig

Determining the Most Effective Medium of Telling a Story that Results in the Greatest Empathic Change

Location of Research:
Harrison High School

Mentor:
Ms. Allison Blunt

WIll be Attending:
University of Michigan

Intended Major:
Business

Fairs & Awards:
JSHS 2024-3rd Place Behavioral Science
Regeneron Science Talent Search-Participant
HHS Symposium 2022, 2023, 2024

Holocaust education (HE) has been shown to increase empathy, one's willingness to be an upstander in difficult situations, develop higher critical thinking skills, and contribute to open-mindedness. Learning about the Holocaust through the stories by Survivors has been supported as the most effective method of imparting holocaust education, but the number of Holocaust survivors is dwindling steadily. Therefore, the purpose of this study was to discover the best way to keep a story alive for future generations that results in the greatest empathic. The methodology entailed dividing 288 high school students into 3 groups: one that heard the survivor speak, one that heard a narrator of oral tradition speak, and one that watched a video of the survivor speaking. Each group completed the Interpersonal Reactivity Scale scale both before and after the presentation that measured empathic change. It was found that HE does improve empathy levels ($P<0.0001$), and the narrator of oral tradition ($p=0.9756$) provides a closer impact then a video of the survivor ($p=0.0740$). It was also found that females ($p=0.0054$), and students who identified as Jewish (0.0372) had the greatest empathic change while age had no significant impact ($p>0.1$). This concludes why HE must be kept alive, and which demographics are impacted the most by the presentations. The implications of this study is that future generations, barring any new technological advances, should experience HE through narrators of oral tradition.

Determining the Most Effective Mediums of Telling Stories That Results in the Greatest Empathic Change

Introduction

1938 Germany: Stores marked with "Jude" targeted during Kristallnacht

2017 USA, Wellsville, N.Y. : High School dugout

"Have definitely heard about the Holocaust." (Boston Globe, 2021)

- 15% nationally believe holding neo-Nazi views is acceptable

Students who had HE in high school are more open-minded to different viewpoints including race and sexual orientation and demonstrate higher critical thinking skills

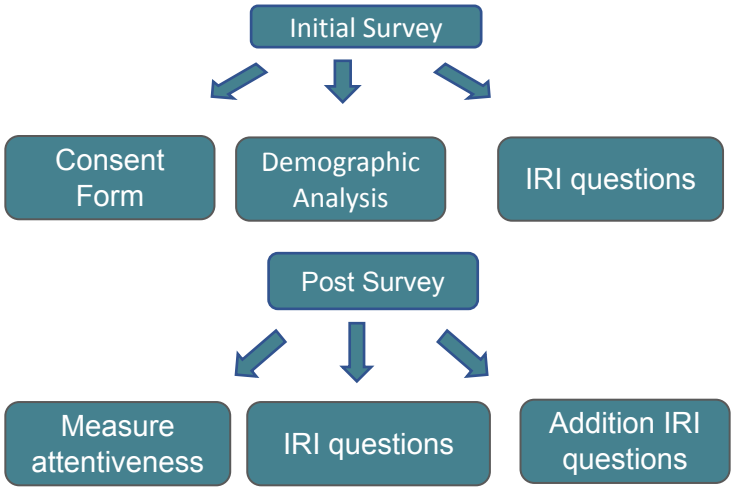
Methodology

Participants:

- IRB approval, parental, and informed consent received
- 288 High School students
- Split between three mediums: Holocaust Survivor present, In-person narrator, Video

Interpersonal Reactivity Index (IRI)

Measures dispositional empathy by responding to how well questions describe them in certain situations from 1-10



Results & Analysis

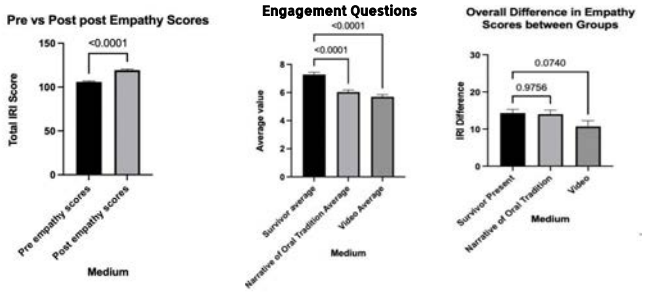
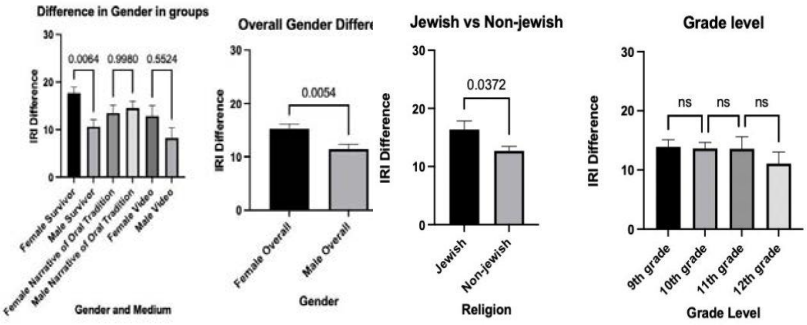


Figure 1-3: Differences in empathy score and IRI score across mediums



Figures 4-7: The effect of varying demographic differences, gender, religion, grade level, on empathy change

Conclusion & Future Research

Hypothesis was not supported

- Video did not result in the greatest gain in empathy or greatest engagement
- Holocaust education, regardless of medium, resulted in a significant increase of empathy
- The engagement of the Holocaust survivor presentation was significantly higher than other mediums

Limitations

- All participants are from the same geological background and school district
- No script for speakers so each presentation slightly different and potentially more impactful

Future Research and Implications

- As technology advances, more effective technological mediums will emerge and become readily available
- Sheds light on the role of technology in education and potential overreliance on the use of technology and videos for education purposes

Alexia De La Jara

Analyzing Algorithm Content Recommendation in the Digital Age: Exploring Interest Reinforcement and Diversity on TikTok

Location of Research:
Harrison High School

Mentor:
Mrs. Catherine Johnson/Ms. Allison Blunt

WIll be Attending:
Erasmus Rotterdam University

Intended Major:
International Business

Fairs & Awards:
WESEF 2024 - US Agency for International Development (USAID) Science Champion Award, Behavioral Sciences
WR JSHS 2024 - Participant
Somers 2022 -3rd Place, Behavior

As a result of its short and captivating videos, TikTok has become one of the most used apps by Gen Z, with over 800 million monthly active users. In 2019 and 2020, TikTok became the most downloaded iOS app in the teenage audience, with around 1 billion users. While enhancing user experience, this algorithm raises concerns about the creation of echo chambers, limiting exposure to diverse ideas. According to a study conducted by Media Matters for America, the algorithm's influence extends beyond content curation, exposing its propensity to drive subsequent recommendations toward extremist, bigoted, and violent themes. Given teens' extensive use of TikTok, the app holds significant power in forming viewpoints, prompting concerns about the algorithm's impact on stereotyped thinking and attitudes toward outgroups. This study aims to investigate the algorithm's portrayal of varied interests and ethnicities, focusing on its ability to reinforce or challenge stereotypical viewpoints among adolescent users. A survey of 12-18-year-old high school students examines the relationship between wanted and recommended items on the "For You Page." Furthermore, the study examines if prejudices about specific groups are maintained in information linked to #crime, #lawyer, and #doctor. This study seeks to explore the impact of TikTok on the worldviews of high school students by analyzing the function of the app's algorithm in shaping their perspectives.

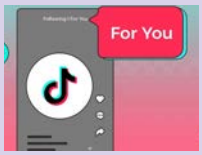
Analyzing Algorithm Content Recommendation in the Digital Age: Exploring Interest Reinforcement and Diversity on TikTok

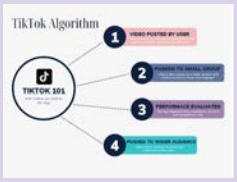
Introduction

- Most used app by Gen Z
- Over 800 million monthly active users (Taulli, 2020)
- Personalized "For You Page"

Algorithm

Set of rules used to prioritize the content





- Designed to learn what an individual likes and is interested in based on their activity on the app
- Based on their interactions with the videos **(likes, comments, and follows)**

Possible creation of **echo chambers**: an environment in which a person encounters only beliefs or opinions that coincide with their own

Methodology

The TikTok algorithm reinforces the user's preferences

The TikTok algorithm does not reveal ethnic and gender diversity, potentially reinforcing echo chambers.

Variables

Subjects studied
- Suburban students
- In the US
- Teenagers 13-18 yrs old.

App selection
- TikTok: Most downloaded IOS app
- 500 million users
- Biased content

- IV: interests, perspective, goals of the viewer
- DV: diversity and user preferences
- Controlled: TikTok account,

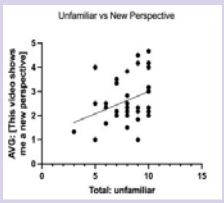
Procedure

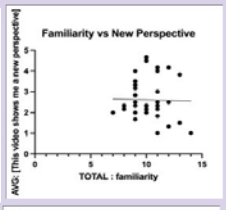
Part 1
-Demographic
- Questions relating to what content they would like to see on TikTok.

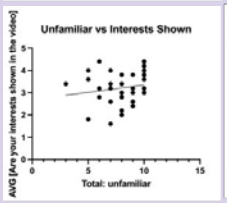
Part 2
Measuring of interest level on fyp to determine if the users are being exposed to new ideas on TikTok.

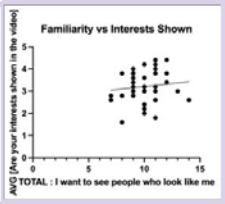
Part 3
- Search up 3 hashtags : # Crime, #Doctor, #Lawyer.
- Counting different ethnicities.

Results & Analysis



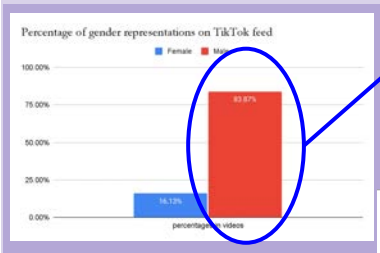




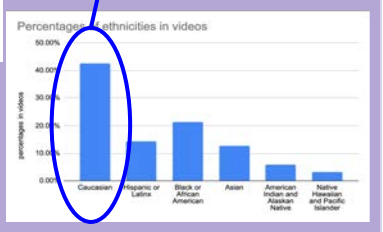


There is only only one small correlation

However, overall there is no correlation between preferences and the content on the FYP.



Overrepresentation of Caucasians and Males



Overall, a lack of diversity → Inaccurate representation of demographics

Conclusion & Future Research

Results did not match up with preliminary results:

Content that aligns to their demographic background (ethnic and gender), indicating reinforcement of echo chambers.

Hashtag search showed that some groups were more prominent to certain attributes → reinforces stereotyping

Recommend content from **specific ethnic groups and genders**,

Hackett and Hogg's "The Diversity Paradox" → **individuals who value diversity find themselves surrounded by like-minded individuals.**

Conclusion

Hypothesis 1: Not supported by evidence → people do not see what they claim to want to see.

Hypothesis 2: Not enough ethnic and gender diversity through the hashtag search.

Future research

Application to other social media platforms
Creation of less Biased Algorithms
AI face analysis

Isabella Estroff-Liberti

The Extent to which the U.S Political System Fails Women in Domestic Violence Situations

Location of Research:
Harrison High School

Mentor:
Ms. Robbin Schlaf

WIll be Attending:
University of Wisconsin

Intended Major:
Political Science

Fairs & Awards:
Somers Science Fair 2022 - 3rd Place, Behavioral Sciences
HHS Symposium 2022, 2023, 2024

According to the Domestic violence hotline, 25% of girls experience an incidence of domestic violence before the age of 18 and 20% of all women are abused at some point in their marriage. The US political system tends to focus on trade and industries, which may lead to the promotion of monopoly and inequality . The purpose of this study was to determine if domestic violence affected people of all SES equally within a suburban county in New York. The methodology involved collecting police FOIL reports with incidences of domestic violence per police beat for the suburban New York town in the years 2000-2022. Each beat was divided into 4 sections and a random generator was used to pick out four streets from each section. For every street the price of four different houses was found using Zillow. The average house price per beat was used to estimate the wealth of that given area, so that the beats could be ranked from highest SES to lowest. This data was compared to data obtained from the entire county. The hypothesis was not supported as the data clearly showed areas of lower SES in both the town and county and had significantly increased reports of Domestic Violence ($p<.05$). A potential reason for this could be that the poorer the person is, the more likely they may be to turn to the police in times of distress, whereas wealthier people may enlist the help of lawyers and other professionals.

The Extent to which the U.S Political System Fails Women in Domestic Violence Situations

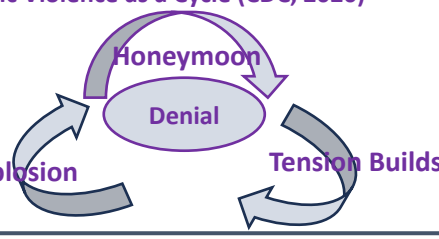
Introduction

Every 24 minutes (National Domestic Violence Hotline)

1 in 4 under 18 (CDC 2020)

Domestic Violence as a Cycle (CDC, 2020)

Lack of resources may make this cycle continue



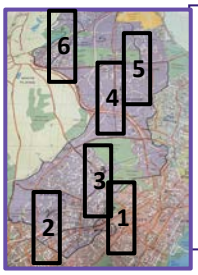
Highland Falls 2023

Avesta Housing 2023

Methodology

Part 1: Relationship Between SES and Reported Cases of Domestic Violence from 2000 - 2021 in a Suburban New York Town

Domestic Violence Data: Foil Reports were filed requesting Incidences of Domestic Violence from local Police Department 2000-2022 by Police Beat



#1 Used a random number generator to randomly select a street in a police beat

#2 Repeated step #1 16x/beat

#3 Used a random number generator to randomly select 5 houses on each street

#4 Recorded house price of each house using Zillow

Part 2: Relationship Between SES & Reported Cases of Domestic Violence from 2000 - 2021 in a Suburban New York County

Social Factor Data: Social factors such as % white and median household income collected through US Census Bureau

Domestic Violence Data: The Office for Women shared DIR's from 2018-2022

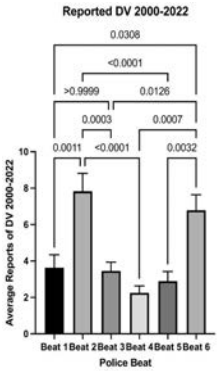
DIR'S from Office for women

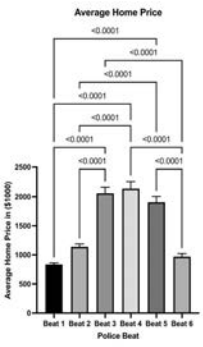
US Census Bureau For social factors

Compare data using Graphpad Prism (linear regression)

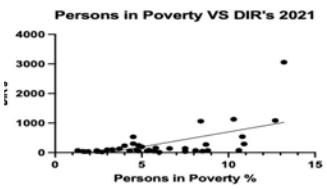
Results & Analysis

Part 1: Relationship Between SES and Reported Cases of Domestic Violence from 2000 - 2021 in A Suburban New York Town

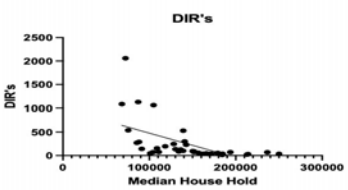




Part 2: Relationship Between SES & Reported Cases of Domestic Violence from 2000 - 2021 in a Suburban New York County



R-squared value of .3565 and the R-value of .5970762095



R-squared value of .3603 and the R-value of -.6002499479.

Conclusion & Future Research

Hypothesis was supported

Greater DIRs In lower SES

Greater DIRs in lower % white

Police had little effect on DIR rates

Although it could also mean that as # of police officers increase they were filling more DIRs

Limitations:

Safety isn't an equal opportunity

Escaping and resources are more accessible to the wealthy

Only access to reported data

Applications:

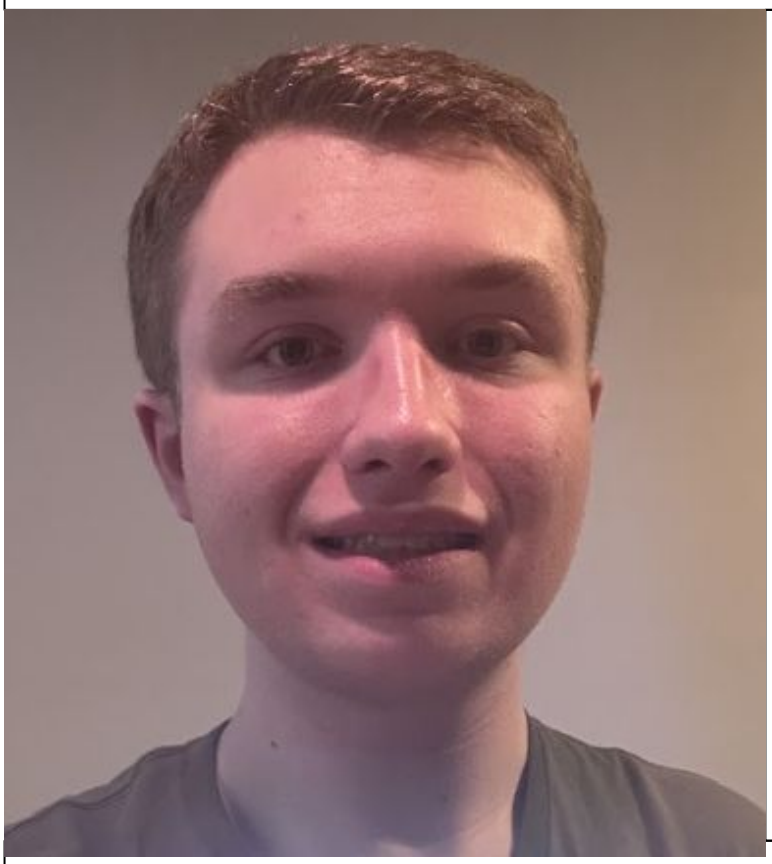
- Identify people at risk for Domestic Violence so quicker action can be taken.
- Implement protocols to prevent Domestic Violence

Further Research:

- See if men are blind to Domestic Violence when they are implementing abuse towards a women
- Construct a survey containing questions that would identify a toxic relationship

Ben Gold

The Effect of Diet Composition on the Role of *Ruthenibacterium lactatiformans* in Parkinson's Disease



Location of Research:
Home / Harrison High School

Mentor:
Mr. Joseph Boktor

WIll be Attending:
Binghamton University

Intended Major:
Biomedical Engineering

Fairs & Awards:
WESEF 2024 - Participant
WR-JSHS 2024 - Local Speaker, 1st Place Biology / Medicine I
Somers 2022 - Participant
HHS Symposium 2022, 2023, 2024

Parkinson's disease (PD) is a condition that is primarily characterized as a brain disease due to its core symptom of neurodegeneration, but research has implied that it is also a digestive disorder. Gastrointestinal complications can appear in patients during early stages of the disease, often decades before the onset of neurological symptoms. The microbiome is a system of microbes located primarily in the GI tract whose primary role is aiding in digestion, but it may connect to PD. One possible mechanism is that some species of microbes release neurotoxins as a waste product from metabolizing food, which then pass through the blood brain barrier and damage neurons. The purpose of this study was to see which dietary factors PD patients, on average, consumed more of than controls; and which species of microbes were more prevalent in patients with high consumption of these dietary factors. It was hypothesized that PD patients will report overall increased consumption of animal proteins, and show consistent patterns of elevated and/or depleted relative abundance of some microbial species. Data collected by Wallen et al. (2022) from 490 PD patients, as well as 234 controls, containing the abundance of species within subjects' microbiomes, as well as lifestyle factors, including diet, was analyzed in version 4.2.2 of R. Results show that PD patients averaged higher relative abundances of *Ruthenibacterium lactatiformans* than controls, especially for PD patients who consumed higher amounts of animal products. It is known that upon metabolizing d-glucose, *R. lactatiformans* produces acetic acid, which has been implied to strengthen the GI tract against penetration by PD-causing neurotoxins. Grain consumption correlates with a decrease in the abundance of *R. lactatiformans*, thus lowering rates of acetic acid production. Because of these seemingly contradictory roles of carbohydrates, future research will formulate a dietary plan that finds the balance of grain consumption necessary to optimize *R. lactatiformans* levels.

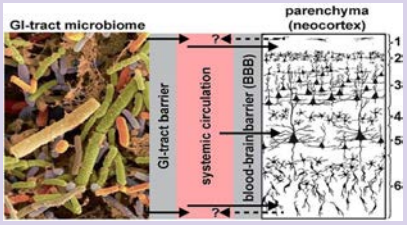
The Effect of Diet Composition on the Role of *Ruthenibacterium lactatiformans* in Parkinson's Disease

Introduction

- Neurodegenerative
- Loss of motor functions (Shrimanker et al, 2022)
- Doubled globally since 2015 (Qi et al, 2023)

Common symptoms of PD

- GI issues in PD patients (Qi et al, 2023)
- Diet may connect to PD by causing changes in microbiome
- Bacteria producing neurotoxins upon consuming proteins
- Hypothesis: animal protein consumption correlates with PD



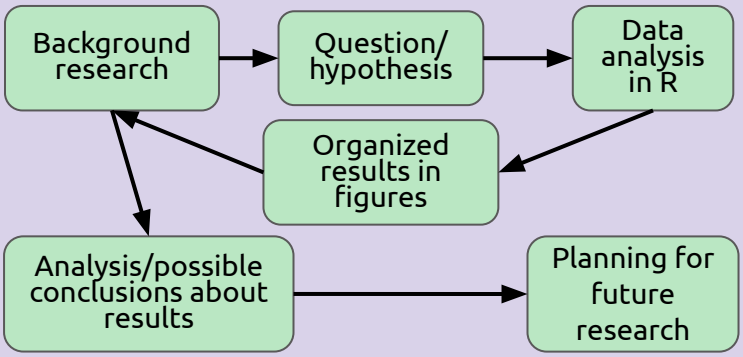
Methodology

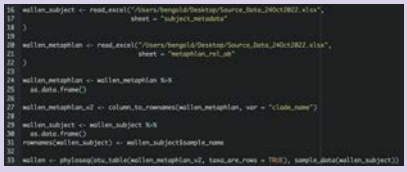
Data collection:
- From Wallen et al, 2022
- Diet, gut bacteria species

Independent variables:
- PD/control status
- Consumption frequency of different food groups

Dependent variable:
-Abundance of *R. lactatiformans*

Student Role in Study:





Code to create phyloseq object for data analysis

Results & Analysis

Group	Taxonomic category	Enriched or depleted in PD patients	Coefficient	No. of subjects found in
Lachnospiraceae	Family	Depleted	-0.0260808585	723
Actinobacteria	Phylum	Enriched	0.0321423494	724
Actinomyces oris	Species	Enriched	0.0020004807	345
Ruthenibacterium	Genus	Enriched	0.0110714040	707
Ruthenibacterium lactatiformans	Species	Enriched	0.0110714040	707
Clostridia	Class	Depleted	-0.0246593454	724
Clostridiales	Order	Depleted	-0.0246593454	724
Roseburia	Genus	Depleted	-0.0169615787	660

Corresponding dietary factor	Linear coefficient for PD patients (r_1)	Linear coefficient for all patients (r_2)	Difference between r_1 and r_2
Grains	**-0.29783**	**-0.02737**	**-0.27046**
Animal proteins	**0.04968**	**0.05703**	**-0.00735**
Fruits/vegetables	**-0.34315**	**0.08957**	**-0.43272**
Nuts	**0.1398**	**-0.3779**	**0.5177**
Yogurt	**-0.2741**	**0.3076**	**-0.5817**

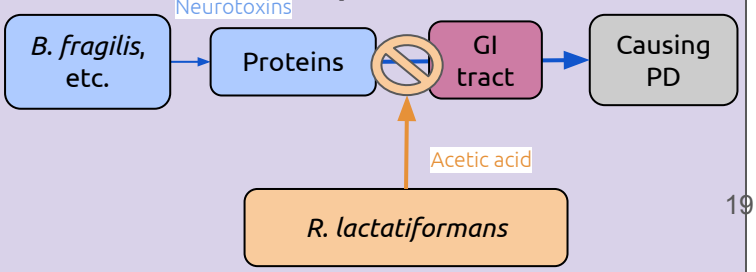
- *R. lactatiformans* enriched in PD group

- Beta coefficient: Pearson's correlation with SD standardized to 1
- Grain consumption correlates with decrease in *R. lactatiformans*
- Lack of evidence for animal proteins affecting *R. lactatiformans*

Conclusion & Future Research

Hypothesis mostly unsupported

- Certain bacteria species' abundance changed with PD
- However, *R. lactatiformans* did not seem to interact with animal proteins
  - **Look into animal protein's effect on other implicated bacteria species**
- *R. lactatiformans* feeds on dextrose, produces acetic acid, which strengthens gut barrier
  - Therefore, consuming carbs (specifically dextrose) can prevent PD
  - However, *R. lactatiformans* levels decrease with higher grain consumption
    - **Find balance of consumption frequency, develop diet plan to prevent PD**



Emma Jonisch

Investigating the Extent to Which Fluoxetine Hydrochloride Affects Tumor Necrosis Factor Signaling in Mutant *Drosophila melanogaster* with Eiger Overexpression

Location of Research:
Harrison High School

Mentor:
Ms. Allison Blunt

WIll be Attending:
Cornell University

Intended Major:
Statistics

Fairs & Awards:
Regeneron Science Talent Search 2024
Upstate JSHS 2024 - 3rd Place Speaker, Medicine & Health
Regional JSHS 2024 - 2nd Place, Medicine & Health
WESEF 2024- 4th Place in Medicine & Health
Somers 2023- 2nd Place Bioinformatics

Inflammatory diseases occur when the immune system attacks its own tissue. Tumor Necrosis Factor (TNF) is an inflammatory protein that, when inhibited, decreases inflammation. Tzeng (2021) found that patients with depression taking antidepressants, specifically selective serotonin reuptake inhibitors (SSRIs), had a decreased likelihood of developing psoriasis, an inflammatory disease, compared to those not taking antidepressants. In some experimental models, fluoxetine hydrochloride (prozac), an SSRI, has been shown to have anti-inflammatory effects however the mechanism by which this works remains unclear. The purpose of this study was to determine whether fluoxetine hydrochloride inhibits TNF signaling in mutant *Drosophila melanogaster* with Eiger overexpression in the eyes. Eiger is a chemical messenger triggering the JNK pathway, which regulates TNF and has been demonstrated to be an important pathway in inflammatory disorders. When Eiger is overexpressed, the cells die, and a reduced- eye phenotype is created. A dose response study was conducted that exposed *D. melanogaster* with the Eiger phenotype to 0, 1.6, 16, 160, and 1000 μM concentrations of fluoxetine hydrochloride. ImageJ was used to measure the area, length, and width of the eye and a metric was created to compare eye phenotypes. Results showed that there were significant changes in the phenotypes between the 0 μM and the 1000 μM concentration of fluoxetine for females ($p<.0001$) and for males ($p<.001$), indicating that fluoxetine hydrochloride may have inhibited TNF signaling. However, the changes in surface area were not significant in males between the 0 μM and the 1000 μM concentrations ($p>.05$), indicating a reduced- eye phenotype was not created. The change in average width/ length between the 0 μM and 1000 μM flies' eyes was significant for females ($p<.005$), indicating a change in shape, but not for males ($p>.05$). Further experimentation is warranted to determine whether fluoxetine hydrochloride can be used as an adjunctive treatment for inflammatory diseases in humans.

Investigating the Extent to which Fluoxetine Hydrochloride Affects Tumor Necrosis Factor Signaling in Mutant *Drosophila melanogaster* with Eiger Overexpression

Introduction

TNF = important protein involved in inflammation → **JNK** pathway regulates TNF

TNF inhibitors are used to treat and ↓ inflammation

Depressed Patients

SSRIs → ↓ Psoriasis

No SSRIs → ↑ Psoriasis

(Tzeng et al., 2021)

Mechanism/Hypothesis

Fluoxetine ↑ serotonin

Inhibits TNF (Song et al., 1994)

Anti-inflammatory

Drosophila melanogaster

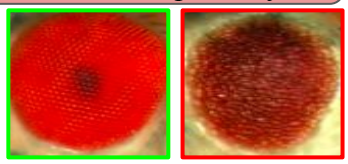
Convenient model

Different system than humans, similar through JNK pathway

Eiger: chemical triggering JNK in flies

Ommatidia: optical units in *Drosophila* eye

Eiger overexpression
-smaller eye (Igaki, 2002)
-uneven ommatidia distribution (Whitworth, 2023)



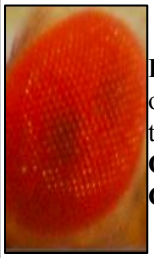
Methodology

IRB approval → Obtain 4 40 mg Prozac pills from mentor MD → Create Solutions & Fly Food

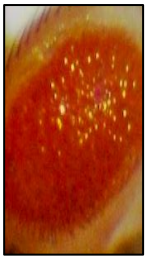
Create Cross & 0 µM Vials → Photograph and Classify Fly Eyes → Analyze Results & Form Conclusions

Independent	Dependent	Control
Concentration of fluoxetine hydrochloride	Area, length, width, ommatidia distribution	22°C 12 hour of light and dark 3 mL of food

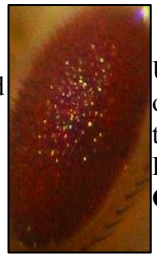
1: Normal Fly Eye **2: Mildly Disrupted** **3: Very Disrupted**



Even omma-tidia **Orange**, **Circular**



Some what distributed omma-tidia, **Dark orange**, **Ovular**

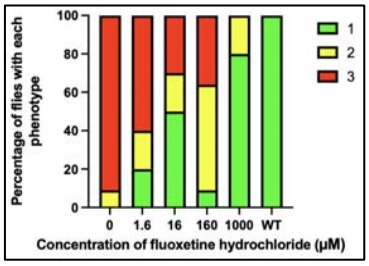


Uneven omma-tidia **Red**, **Ovular**

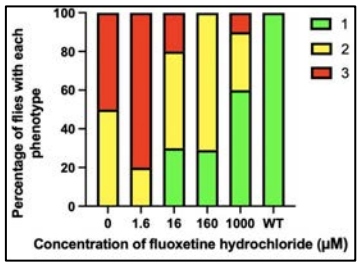
Results & Analysis

Cross Eye Phenotype

Female



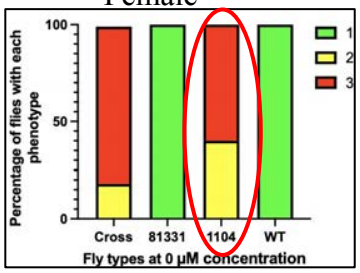
Male



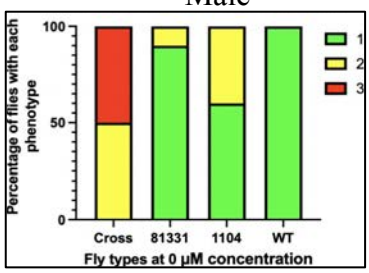
Supports: As Fluoxetine ↑, Normal Eye Phenotype ↑

Control Eye Phenotype

Female



Male



As Expected, other than GAL4 (1104), which is not normal

As Expected

Conclusion & Future Research

Limitations	Future Research
Drosophila model - Inflammation could not be directly analyzed	Immunohistochemistry to analyze TNF pathway
Limited Resources - Microscope with Maximum 40x Magnification	Electron microscope to measure amount of ommatidia
Fluoxetine hydrochloride is only slightly soluble in distilled water	Electron microscope to measure amount of ommatidia
Female GAL4 eye phenotype was mildly to severely disrupted	Test GAL4 flies at different concentrations of fluoxetine

IF fluoxetine does inhibit TNF signaling → THEN, it can be good adjunctive treatment for inflammatory disease patients

Lucia Lammers

Spectroscopic and Colorimetric Analysis of Textiles Dyed with Local Invasive Plant Species and Waste-derived Mordants

Location of Research:
Home/HHS/Fashion Institute of Technology (FIT)

Mentor:
Dr. Julian Silverman, FIT

Will be Attending:
Georgia Institute of Technology

Intended Major:
Environmental Science

Fairs & Awards:
2024 Regeneron ISEF: 3rd Place & EPA Award
Regeneron STS 2024 - Top 300 Scholar
NYSSEF 2024 - 1st Place in Earth & Environmental Sciences/ISEF Finalist
WESEF 2024 - 2nd Place Environmental Science
JSHS 2024 - Regional 1st Place Earth & Environmental Science
Upstate JSHS 2024 - Regional Speaker
Somers 2023 - 2nd Place Environmental Science
HHS Symposium - 2023 & 2024

Synthetic dyes used by the fashion industry pollute aquatic ecosystems and contribute to the bioaccumulation of toxic compounds in organisms. Natural dyes are alternatives to synthetics whose colors can vary in hues, values, and chromas; however, they can lack adequate color fastness which can be improved by mordant application. This study aimed to determine whether extracts from the leaves and stems of invasive plant species paired with waste-derived mordants can create both material efficient and cost-effective natural dyes with large color ranges. Local invasive plant species Norway Maple (Acer platanoides), Tree of Heaven (Ailanthus altissima), and Porcelain Berry (Ampelopsis brevipedunculata) were chosen, because they are accessible and abundant; removing them for dyestuff can promote biodiversity. Dyestuffs from these plants were combined with waste-derived mordants made from rusted iron metal, recycled aluminum cans, and calcium from egg shells. Infrared (IR) spectroscopy revealed wavenumber peaks at 443-605 cm-1 representing bonds between natural dye chromophores (C=O) and iron ions. Peaks at 1570 cm-1 and 600 cm-1 indicated bonds between natural dye chromophores and Al2O3. The Munsell Color Matching System was used to reveal that all dye-mordant complexes produced wide ranges of colors. A Life Cycle Assessment (LCA) determined the material efficiency and cost-effectiveness of dyeing cotton textiles with Norway Maple and different mordants. These results determined Norway Maple paired with aluminum acetate as the most effective dye-mordant complex due to its high chromas, safety, and cost-effectiveness. These methods may aid in repurposing invasive plants and reducing the environmental impacts of textile dyes.

Spectroscopic and Colorimetric Analysis of Textiles Dyed with Local Invasive Plant Species and Waste-derived Mordants

Introduction

Hypothesis: Local invasive plant species which dye textiles can be paired with mordants from local municipal waste to create colors with large ranges of hues, values, and **high** chromas

Problems:

Synthetic dyes **pollute** aquatic ecosystems with toxic compounds

Invasive plant species decrease the biodiversity of ecosystems

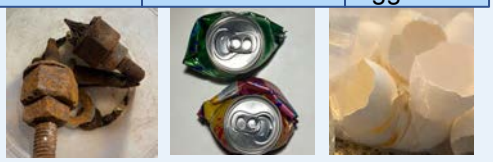
Municipal waste contaminates soil & produces greenhouse gases

Solution:

Dye

Invasive Plants

Rusted Iron | Aluminum Cans | Egg Shells



Mordants (Dye Fixatives)

Methodology

Mordanting:

Combine municipal waste & vinegar to create:

Waste-derived Mordants

Iron | Aluminum | Calcium

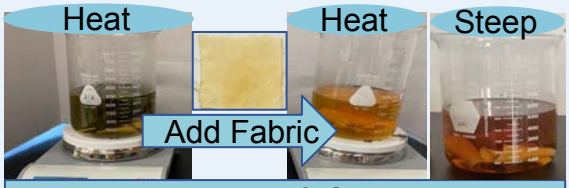
Cotton Fabric

Pre-mordanted Fabric

Dyeing:

Invasive Plant Species

Norway Maple | Tree of Heaven | Porcelain Berry

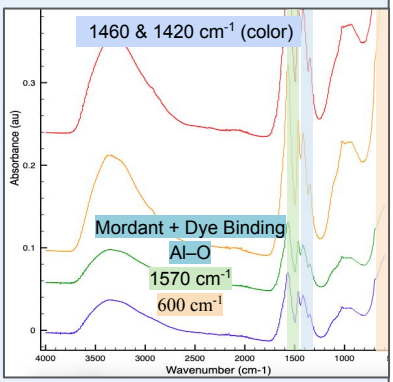


Dye Bath: Leaves & Stems + Water

Results & Analysis

Infrared spectroscopy supports:

- that these mordants & dyes can color textiles
- the capability to increase dye fixation



Munsell Color Matching System

Large ranges of hues created:
2.5YR, 5Y, 10YR, 5RP
Chromas (saturations) assessed:
Aluminum mordant samples: 6 (high)
Large ranges of values created

Life Cycle Assessment (LCA)

Norway Maple + Aluminum Acetate	PMI (product mass intensity): 295 ¢/g (cost per gram): 1.1
Commercial Synthetic Dye	PMI: 53 ¢/g: 2.1 More dangerous hazard & precautionary statements

Conclusion & Future Research

Hypothesis Supported: Dye-mordant complexes created large ranges of colors

✅ Infrared Spectroscopy**:** Successful textile **coloration** & dye **fixation** evident

✅ Munsell Color Matching Systems:
- Large ranges of saturated colors created
- Norway Maple-aluminum acetate **= most saturated color**

✅ LCA: Norway Maple-aluminum acetate is a **cost-effective & safe** alternative

Conclusion: Norway Maple-aluminum acetate = most **optimal** dye studied

Applications to Wearable Textiles:

1) Successfully **repurposes** invasive plants & municipal waste
2) Displays colors with high chromas **preferred** by consumers
3) Cost-effective = ↑ **affordability** of eco-friendly fashion

Magda Mani

How the Adaptation of *Fucus vesiculosus* to Changing Nutrient Conditions in the LI Sound Affects the Herbivory of *Littorina littorea* and *Littorina obtusata*

Location of Research:
University of Connecticut

Mentor:
Dr. Catherine Matassa

Will be Attending:
University of Connecticut

Intended Major:
Biology

Fairs & Awards:
NYSSEF 2024- 3rd Place, Env. Science
WESEF 2024 - Honorable Mention, Env Science
JSHS 2024 - Regional Speaker Plant & Animal
Regeneron STS 2024- Applicant
WESEF 2023 - 3rd Place Env.Science & SJWP Regional Prize
SJWP 2023 - New York Competitor
Somers Westlake 2022 -1st Place Env Science
HHS Symposium- 2022,2023,2024, Designated Speaker 2023

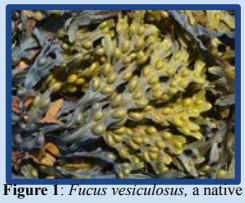
The Long Island Sound nutrient gradient runs from West to East. The Western LI Sound's higher nutrient content is driven by dense population sewage and fertilizer runoff, posing an issue for native species that have to adapt to elevated nutrient levels. Variations of nutrient concentrations in the Sound could result in different adaptive methods of seaweed and affect feeding preference of herbivores. The purpose was to determine if Fucus vesiculosus, an abundant seaweed in the sound, adapted to its local environmental conditions; and to see if the snail species: L.obtusata, a direct developer, and L.littorea, a broad disperser, preferred seaweed from one location over the other. The study consisted of two parts: 1. A reciprocal transplant study was conducted where 24 samples of F.vesiculosus from the West and East were extracted. 2. A cross feeding study, where 48 containers of both L.obtusata and L.littorea had the choice to graze on either Western or Eastern F.vesiculosus. Before and after replantation and grazing, the samples were weighed, and surface area was measured using ImageJ. After 1 month, 10/48 transplanted samples were found. Results indicated a decrease in both mass and surface area for samples in both plantation sites, the differences were not significant ($p > .05$). A power analysis revealed that recovering 5/12 samples would likely result in significant effects ($p < .05$) of both source population and transplant site with high statistical power (power = 0.9). A two-way ANOVA was conducted to determine the relationship between seaweed location and snail grazing. Results indicated L. littorea significantly preferred western samples ($p < .05$) whereas L. obtusata exhibited no preference. Seaweed consumption was dependent on snail species. The implications were that the nutrient dense conditions affected the adaptation of the seaweed and subsequent feeding behavior of broad dispersers; human induced conditions impact food web relationships.

How the Adaptation of *Fucus vesiculosus* to Changing Nutrient Conditions in the LI Sound Affects the Herbivory of *Littorina littorea* and *Littorina obtusata*

Introduction

Eutrophication: enrichment of nutrients due to excessive runoff/pollution in a body of water → excess nitrogen concentration

Decomposition of dense algal growth leads to increase of **hypoxia** (decrease of oxygen in the water column)



Nutrient concentration may alter growth rate & function of algal species in LI Sound

Figure 1: *Fucus vesiculosus,* a native seaweed in LI Sound (Stemonitis 2006)

Hypoxic Gradient (W→E)

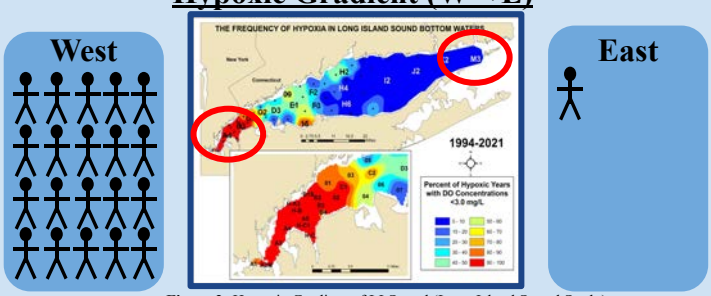


Figure 2: Hypoxic Gradient of LI Sound (Long Island Sound Study)

Methodology

Collection & Transportation

Seaweed extracted off of rocks using paint scrapers, snails hand picked off of fucoid algae.

Figure 3: Western extraction site (Mani, 2023)

Figure 4: *Littorina littorea* (Mani, 2023)

Figure 5: *Littorina obtusata* (Mani, 2023)

Measuring & Labeling

Figure 17: Measurement setup (Mani, 2023)

- ★ Scanned using flatbed scanner
- ★ Scans before & after measured in ImageJ
- ★ Biomass of snails weighed
- ★ Normalizes the data

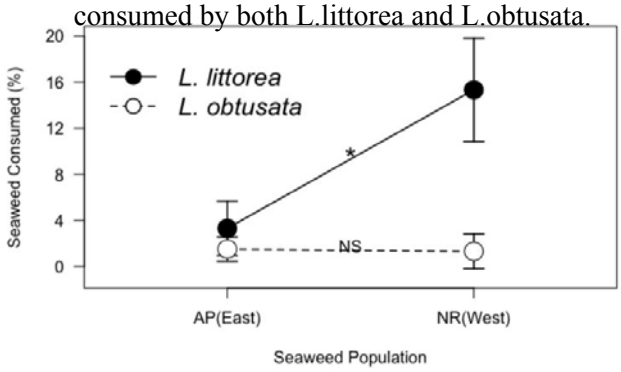
Wet Lab

Figure 18: Flow Through Seawater table, wet lab tank setup (Mani, 2023)

- ★ Each container has a W & E sample
- ★ 3 *L.littorea* and 4 *L.obtusata*
  - ○ Replicate natural abundance

Results & Analysis

Figure 19: Percent of Eastern and Western F.vesiculosus consumed by both L.littorea and L.obtusata.



- ★ Surface area remeasured after 8 days of grazing RStudio used in order to calculate grazing behaviors
- ★ L.littorea consumed 4.6x more Western F.vesiculosus ($p<0.1$)
- ★ L.obtusata had no significant difference ($p>0.05$)
- ★ Interaction: Effect of source population on amount of seaweed consumed significantly depended on snail species ($p>0.05$)

Conclusion & Future Research

Hypothesis somewhat supported

✅ *L.littorea* preferred Western samples

- ★ Environmental component in the West that altered composition of F.vesiculosus
- ★ Acidic conditions alter morphology (Kinnby, 2021)
- ★ Chemical defense system (Svensson, 2007)

❌ *L.obtusata* had no preference

Controlled Wet Lab → no outside influence

⬇

Create outside cage/tank to place snails + samples

Only behavior of snails observed

⬇

Elemental analysis → what changed in seaweed that is causing behavior

Margaret Martinez

The Effect of Magnesium Sulfate Concentration on Fecundity of *Drosophila melanogaster*

Location of Research:
Harrison High School

Mentor:
Ms. Allison Blunt

WIll be Attending:
Mercy College

Intended Major:
Biology

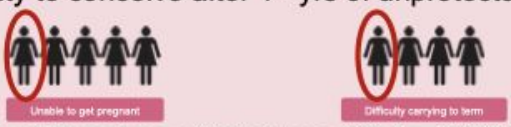
Fairs & Awards:
WESEF 2024 - 4th Place Medicine and Health Sciences
Somers 2022 - Participant
HHS Symposium - 2022, 2023, 2024

Infertility is described as the inability to conceive after one year of unprotected sex. In the United States, 1 in 5 married women are unable to get pregnant after one year of trying. Bloom (2011) found there was a significantly greater number of positive pregnancy tests in women having a greater geometric mean concentration for blood Magnesium. Therefore, the purpose of this study was to determine if magnesium supplementation would increase fecundity or the ability to produce abundant offspring. Drosophila melanogaster was used because they have a short lifespan and reproductive cycle. A dose-response study was conducted where 0.1, 0, 1, 10, 100 and 1,000 mM concentrations of MgSO4 were added to homemade Drosophila cornmeal food using the Bloomington Drosophila Stock Center recipe. At least 6 female and 4 male, 2-4 day old flies of each concentration were transferred to each of 5 grape agar vials and left for 48 hours to lay eggs. Eggs in each vial were counted by placing the grape vial over graph paper under a Zeiss 305 dissecting microscope. Eggs were counted 3x and averaged for each vial. Then, the average number of eggs/female and number of eggs/male were determined for each vial. Results showed that as the concentration of Mg2+ increased, the number of eggs laid per female also increased. However, the trend only approached significance between the control and the 1 mM ($p=0.08$) and the control and 100 mM solutions ($p=0.06$). More testing needs to be done, but Mg2+ supplementation could potentially provide an inexpensive and accessible way to improve fertility.

The Effect of Magnesium Sulfate Concentration on the Fecundity of Drosophila melanogaster

Introduction

Infertility (CDC, 2023)
Inability to conceive after 1+ yrs of unprotected sex



Current Treatment Options (Katz, 2011)
(Cost per successful out)
IVF-$61,377 Medicinal Treatments- $5,894 Median Costs- $61,377

Cazzola, *et al*, 2020
⬆Food Demand = ⬆ Fertilization with N, P, K, but not Mg ➡ Mg not absorbed in soil

Ekiz Yılmaz, et al., 2020
MgSO4 treatment significantly ⬇atretic follicles and ⬆ Graafian follicles

Hypothesis: $MgSO_4$ supplementation will increase fecundity in model flies because supplementation will increase Mg levels mimicking the inadequate intake humans have of $MgSO_4$

Methodology

Independent	Dependent
Concentration of $MgSO_4$ (0.1, 0, 1, 10 ,100, 1000 mM)	• Number of eggs hatched per *female/male Drosophila melanogaster*

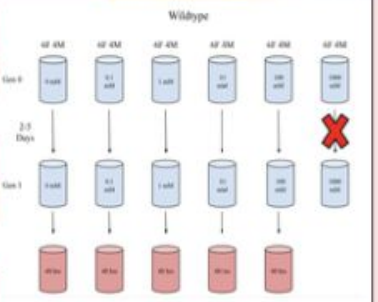
Raise Flies: P1 on $MgSO_4$
Wildtype *Drosophila melanogaster* | $MgSO_4$ diets: 0.1, 0, 1, 10, 100 and 100mM | 1 week

$MgSO_4$ Supplementation: F1
P1 Flies removed: Allow eggs to hatch | 2 Day Supplementation

Agar Vials Transfer
F1 Flies transferred to grape plates | 48hr Egg Laying Period

Sexing
Separated & Counted M & F: Each Concentration

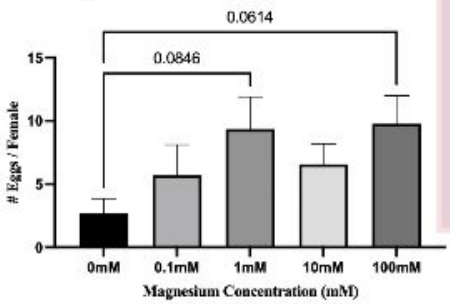
Egg Counting
Counted 3 Times and Averaged



Grape Agar Plates
- Grape juice = translucent hue of purple to agar
- Egg counting

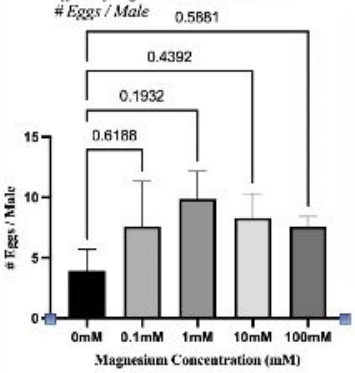
Results & Analysis

Figure 2
Effect of $MgSO_4$ Concentration on # Eggs / Female



All experimental groups fed MgSO4 laid greater # of eggs compared to control
100mM reaching significance

Figure 3
Effect of MgSO4 Concentration on # Eggs / Male



Trend: all concentration groups fed MgSO4 laid a greater # of eggs compared to control

Conclusion & Future Research

Increased $MgSO_4$ supplementation =

✓ Trend of ↑ # of eggs with supplementation

✗ No significant data in any concentration

$MgSO_4$ supplementation = Possible treatment for infecundity

Increase more affordable treatment options for millions of people

Relieve the burden of multiple $$$ treatments

1. Test a larger variety of MgSO4 concentrations→ find optimal concentration

2. Use immunohistochemistry to identify specific effect Mg has

Katherine McCann

Using *Caenorhabditis elegans* to Determine if Broccoli Sprout Extract Can Help Alleviate Epidermal Abrasions

Location of Research:
Harrison High School

Mentor:
Ms. Allison Blunt

WIll be Attending:
University of Rhode Island

Intended Major:
Biology

Fairs & Awards:
WESEF 2024 - Innovations in Biological Sciences Research Award
JSHS 2024 - 1st Place Local Speaker
Somers 2023 - Participant
HHS Symposium - 2023, 2024

Pachyonychia Congenita is an ultra-rare autosomal dominant disease caused by a mutation in the keratin (KRT) genes, specifically keratin 16, 17, 6a, 6b and 6c. Due to the mutation in the keratin genes, those diagnosed with this disease suffer immense epidermal trauma and abrasions. This Disease, especially if diagnosed as a severe case, tends to affect patients physically and mentally.The purpose of this study was to determine if Broccoli Sprout extract, a powdered solute, would alleviate induced epidermal abrasions using *C.elegans* (Caenorhabditis elegans) ;small translucent worms. Broccoli sprout extract offers a means to target the keratin genes through a transcriptional pathway called Nrf-2 and help alleviate physical symptoms associated with Pachyonychia Congenita patients. Similarly, *C.elegans* contain a skn-1 gene similar to the Nrf-2 pathway found in humans and mice, so four different nutrient agar plates,with *E.coli* applied to the surface; contained 10 *C. elegans* each. They were simply cut, then treated with different concentrated Broccoli Sprout Extract (BSE) solutions and wound closure was observed. Results demonstrate, *C. elegans* treated with the Broccoli Sprout extract solutions had faster wound closures and as the concentration increased the relative wound areas decreased. The dish treated with 0.035 mg of extract was the most effective and significant in relation to 0 mg ($p < 0.05$), indicating a threshold for the ideal dosage.

Using *Caenorhabditis elegans* to Determine if Broccoli Sprout Extract Can Help Alleviate Epidermal Abrasions

Introduction

Pachyonychia Congenita (PC)

- Autosomal Disease
- Due to mutated keratin genes
- Targets proteins

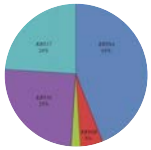


Fig 1: Keratin Gene Mutated

Palmoplantar Keratoderma

- Skin symptoms → causes bumps,cracks, wounds
- Thickening of palms and soles

Nrf-2 Pathway

- Activated = detoxification response
- Targets proteins to change expression when activated

Fig 2: Carolina Biological *C. elegans*

Skn-1 Gene

- Found in C. elegans
- Relates to the function of Nrf-2 pathways
- Possibly affect the expression of proteins

Broccoli Sprout Extract

- Comes from juvenile sprouts
- Contains Sulforaphane: A sulfur containing compound
- When exposed to cells or digested, activated the Nrf-2 pathways

Methodology

E. Coli transferred to Nutrient Agar (Incubated at 37ºC

C. elegans transferred onto established *E.coli* lawn

Incubate!

Wound Assay

- Worms placed in freezer
- Zeiss Stemi used (4.0x)
- Scratched on surface using plastic plate corner

Broccoli Sprout Extract:

0.005mg

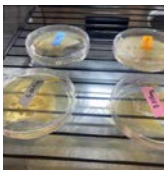
0.020mg

0.035mg

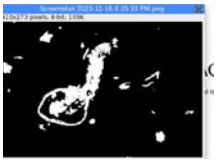
Observation and Data:

Observed After:

- 0hrs
- 6hrs
- 24hrs
- 48hrs

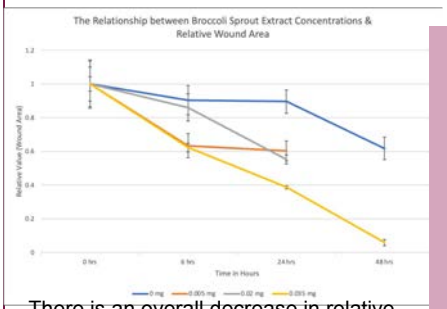


Color Coded by Concentration



Wound Area Measured Using ImageJ

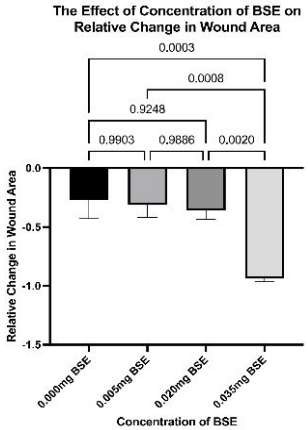
Results & Analysis



There is an overall decrease in relative wound area as the concentration of broccoli sprout extract increases. Error Bars = SEM

- Overall decreased wound area across all concentrations
- 0.035mg = most rapid response

- 0.035mg = significant closure of wound area ($p<0.05$)
- May be possible minimal threshold between 0.020mg and 0.035mg



The bars demonstrate the major differences and relative change in wound areas across the four concentrations. ($p<0.05$).

Conclusion & Future Research

Hypothesis Supported

Increased Broccoli Sprout Extract lead to

✓ Induced Healing Response

✓ Significant exposure when BSE = 0.035mg

Future Research

- Find if Skn-1 gene was affected using mRNA expression
- Conduct further study to investigative optimal dosage
- Identify if Sulforaphane was targeting protein expression based on wound closure

- **Hypothesis Supported**
  - Increase in Broccoli Sprout Extract = Increase in Wound Closure
- BSE may be a treatment option to reduce symptoms caused by Pachyonychia Congenita

Eamon Murphy

The Effect of Mineral Oil on the Growth of *Pisum sativum*.

Location of Research:
Harrison High School & Home

Mentor:
Dr. Christopher Tyler

WIll be Attending:
Rensselaer Polytechnic Institute

Intended Major:
Electrical Engineering

Fairs & Awards:
WESEF 2024 - NASA Earth System Science Award
JSHS 2024 - Participant
HHS Symposium: - 2024

Mineral oils are widely available, petroleum products that have many uses, specifically as a lubricant for machinery. If a machine is not sealed properly, or during maintenance the oil is not properly disposed of, lubricating oil can enter the environment. Mineral oils are minimally biodegradable and can cause damage to soils by blocking ventilation, which limits the air, nutrients, and water that can permeate the soil. This may negatively affect plant growth. The purpose of this study was to determine a threshold where mineral oil becomes toxic to plants, by monitoring the growth of green peas, Pisum sativum (green pea cultivar). Soil samples were mixed with different amounts of mineral oil in order to create different concentrations of mineral oil. The mixtures were used as growth substrates for a Pisum sativum (green pea cultivar) plant. 6 groups and a control were created. Over a period of 14 days the plants were grown and measured. After the experiment was completed the soils were disposed of in a proper recycling facility. In measuring the plants rulers, scales, and a dehydrator were used. The results showed that over a 14 day period, as the concentration of mineral oil increased, average time to germination, average plant height, average leaf area, number of leaves, average biomass, and survivability all significantly decreased ($p<.05$). The implications are that it may be necessary to regulate the distribution of mineral oils to maintain the health of environmental ecosystems.

The Effect of Mineral Oil on the Growth of *Pisum sativum*

Introduction

- Machinery Used
- Mineral Oil Enters Environment
- Mineral Oil Remains In Environment
- Has Potential Damaging Effects On Plants

(minifinaldrives, 2023)

Figure 1. Lubricants leaking from machinery

- Biomass in Louisiana marsh reduced

(Hester et al., 2016)

Figure 2. Louisiana marsh before and after crude oil contamination from the Deepwater Horizon oil rig

Purpose

To determine mineral oil and its interaction with plants, as well as a threshold for which plants can survive.

Hypothesis

As mineral oil concentration increases the growth of plants will decline until a lethal threshold is reached.

Methodology

- Part 1: Finding the focus species
- Part 2: Planting the seeds
- Part 3: Maintaining the seeds

Independent Variable: Percent concentration by mass of mineral oil

Dependent Variable: Plant growth

Controlled Variables: Amount of light, amount of water, pots

Figure 3: Setup of experiment

Figure 4: Groups A-G

Results & Analysis

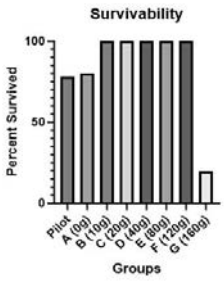


Figure 5: Survival rate of each concentration throughout the duration of the experiment

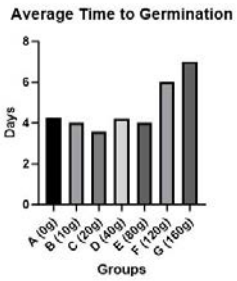


Figure 6: Average time to germination for each concentration

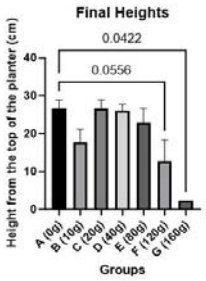


Figure 7: Average final height of the plants at the end of the experiment

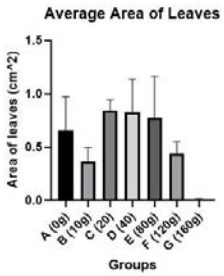


Figure 8: Average area of the leaves at the end of the experiment

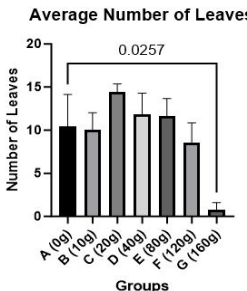


Figure 9: Average number of leaves at the end of the experiment

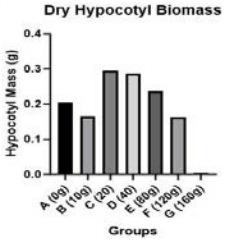


Figure 10: Average biomass of each concentration at the end of the experiment

Conclusion & Future Research

- Survival rate was significantly lower
- Number of leaves significantly decreased
- Time to germination increased
- Area of leaves significantly decreased
- Final Heights significantly decreased
- Biomass Decreased

Limitations

- No direct heat control
- Only one plant species used
- Small sample size could lead to statistically inaccurate results

Future Research

- Direct control over heat and moisture
- Less human interaction to avoid additional gas exchange
- More accurate and precise tools

Stella O'Connell

Investigating the Role of Autophagy and IL-22 Regulation Using a Crohn's Disease Risk Variant

Location of Research:
Regeneron Pharmaceuticals

Mentor:
Dr. Stephanie Lau

WIll be Attending:
Tufts University

Intended Major:
Biology & Community Health

Fairs & Awards:
Upstate JSHS 2024 - 3rd Place Poster
Westchester JSHS 2024 -4th Place Cell Bio
WESEF 2023 - Carl Zeiss Microscopy Award
Somers 2022 - Participant
HHS Symposium - 2022, 2023, 2024

Crohn's disease (CD) is an inflammatory disease impacting the epithelial lining of the gastrointestinal tract. Pathogenesis of CD is attributed to a combination of immunological and genetic factors. T300A (murine T316A) is an allele of the gene ATG16L1 associated with CD. This allele is associated with dysregulated autophagy that can cause inflammation. This study investigated the interactions between T316A and both a pro-inflammatory and regenerative cytokine, Interleukin-22 (IL-22). It was hypothesized that IL-22 will have an increased effect on growth and inflammatory pathway activation in T316A organoids. Organoids were chosen because of their accessibility in CD research. The Incucyte Imaging System was used to monitor the growth of T316A and WT intestinal organoids with differing concentrations of IL-22. IL-22 significantly increased the growth of all organoid types regardless of condition after 5 days ($p<0.05$). Western blots of each genetic condition with and without IL-22 probed for pro and anti-inflammatory pathways associated with IL-22 signaling and autophagy. There was no discernible difference between the activation of each pathway in the WT and T316A organoids; IL-22 activated both types of pathways and had similar autophagic marker activations. IL-22 did not cause more of an adverse effect in organoids with the allele compared to those without the allele. This suggests that people with the T300A allele may not be predisposed to the harmful effects of IL-22 which can impact CD pathogenesis.

Investigating the Role of Autophagy and IL-22 Regulation Using a Crohn's Disease Risk Variant

Introduction

Crohn's Disease (CD): Incurable chronic disease characterized by inflammation of the GI tract

Interleukin-22 (IL-22): Cytokine (immune protein) known for epithelial proliferation, but is pro-inflammatory in excess

Autophagy: Regulates inflammation by recycling unneeded cellular materials

ATG16L1: Autophagy regulating gene that contains a CD risk allele

T300A (humans) / T316A (mice): Allele of ATG16L1 linked to dysregulated autophagy

Gap

Few known studies have investigated the effect of IL-22 on T300A organoids

Purposes

Monitor effects of IL-22 on organoids
Identify differences between WT/T316A organoids

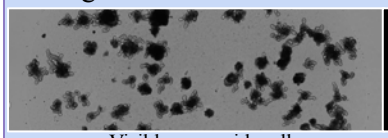
Hypotheses

Part One: IL-22 will have a greater effect on the proliferation of T316A organoids
Part Two: T316A organoids will be more susceptible to pro-inflammatory IL-22 signaling

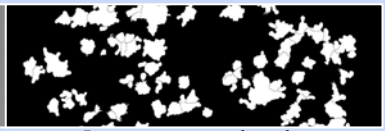
Methodology

Part One: Phenotypical Organoid Growth

1. Mentor harvested organoids from mouse intestinal crypts
2. WT and T316A organoids at day 2 of growth given 1, 10, or 100 ng/mL of IL-22
3. Organoids monitored via Incucyte incubator (next 4 days)



Visible organoid well



Incucyte generated mask

Part Two: Western Blotting

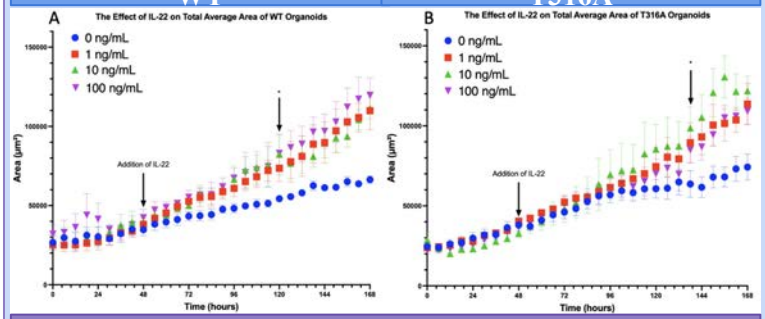
1. WT and T316A organoids are given IL-22 (100 ng/mL)
2. Western blot to probe for downstream antibodies associated with IL-22/autophagy

Primary Antibodies Utilized

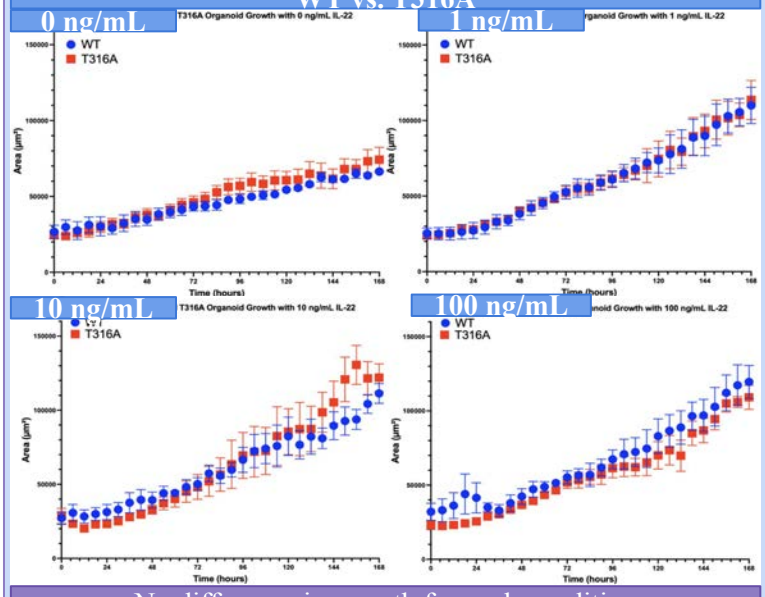
Anti-inflammatory	Stat3, pStat3
Pro-inflammatory	STING, TBK1, pTBK1
Autophagy related	LC3

Results and Analysis

WT vs. T316A

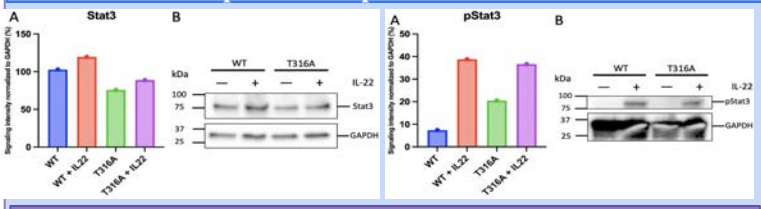


IL-22 increases organoid growth in both types



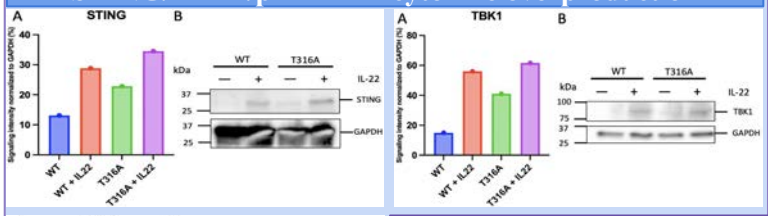
No difference in growth for each condition

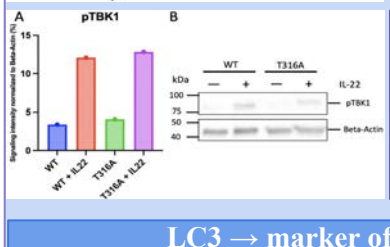
Stat3/pStat3 → epithelial homeostasis



Similar anti-inflammatory pathway activation

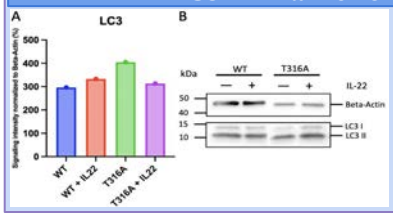
STING/TBK1/pTBK1 → cytokine overproduction





Similar pro-inflammatory pathway activation

LC3 → marker of autophagosomes



Similar levels of autophagic marker

Conclusions, Future Research, and Implications

Hypotheses not supported, but IL-22 did increase organoid growth	Model accuracy → incubator settings Autophagy markers → autophagic flux	T300A may not predispose the harmful effects of IL-22

Stella Perini

Protective Effects of Resveratrol Following Repetitive Head Injury in Wild Type and Amyloid β42 *Drosophila melanogaster*

Location of Research:
Harrison High School

Mentor:
Ms. Allison Blunt

WIll be Attending:
University of Virginia

Intended Major:
Biomedical Engineering

Fairs & Awards:
Regeneron STS 2024- Top 300 Scholar Semi-finalist
WESEF 2024 - BASF Expanding Knowledge in Science Award
Upstate JSHS 2024 - Speaker
WR-JSHS - 1st Place Medicine & Health
SOMERS - 2nd Place Medicine and Health
HHS Symposium: 2023, 2024

Chronic Traumatic Encephalopathy (CTE) is a neurodegenerative disease thought to be caused by repeated head injuries (RHIs). Severe cases of RHI can cause damage to the axons in the brain. This can lead to a buildup of amyloid precursor proteins (APP) which can be broken down into amyloid-B (AB) peptides which disrupt cell communication. Similarly, in Alzheimer's patients, the Amyloid 42 gene increases the production of APP proteins. This study researched whether resveratrol, a polyphenol that has been shown to be neuroprotective, could rescue the effects of RHI and if RHI can trigger the expression of the Amyloid 42 gene. Drosophila melanogaster is a model organism used for studying neurodegenerative diseases because the GAL4-UAS system expresses human genes. A "high-impact trauma" (HIT) device delivered 4 blows with a 5-minute rest to mimic closed head injuries commonly found in contact-sport collisions to the flies raised on both resveratrol and control diets. The negative geotaxis assay was used to assess locomotor ability at 1 hour, 24 hours, 48 hours, and again on days 7,8,9 of life. Wild-type and Amyloid 42 D. melanogaster that were inflicted with RHI on a resveratrol diet performed significantly better immediately post-injury and long term ($p<.0001$). Amyloid 42 gene hit flies did significantly worse than hit Wild type and expressed Amyloid 42 no hit flies long term ($p<.05$). Implications include that resveratrol may provide neuroprotective effects when inflicted with RHI and the Amyloid 42 gene may be expressed when inflicted with RHI.

Neuroprotective Effects of Resveratrol Following Repetitive Head Injury on Wild Type and Amyloid β42 *Drosophila melanogaster*

Introduction

Chronic Traumatic Encephalopathy (CTE)

- Neurodegenerative brain disease
- Repetitive Head Injury (RHI)
- Most commonly found in contact sport athletes
- Diagnosed posthumously
- There are no known cures or treatments for CTE

Resveratrol

Resveratrol = Neuroprotective effects

Resveratrol = Inhibits of Aβ aggregation

Connection to Genetics and Predisposition

Johnson 2010 RHI

Damage to the axons in the brain

Build up of Amyloid Precursor Protein (APP)

Amyloid-β (Aβ) plaques

Disrupts cell communication

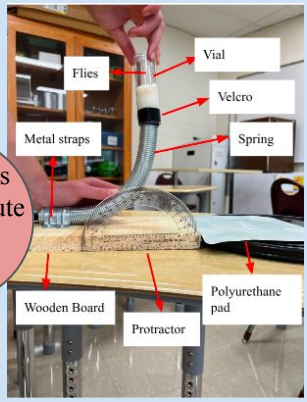
Similar to Alzheimer's Disease patients.. AD (Aβ42 gene) Increases production of APP

Methodology

Adapted device from Katzenberger (2013)

Hit 4 times with 5 minute intervals

90 degree angle

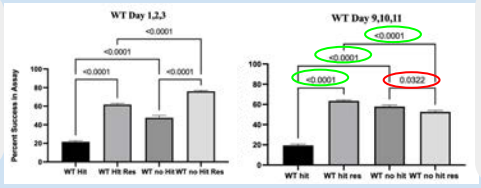


Purpose: Assesses locomotor function of the flies after experiencing repetitive head injury

Wild type (3605)	GAl4 (39171)	Unexpressed "Arctic" Amyloid β42 gene flies (33774)	Amyloid β42 with the "Arctic" mutation
Used as control	Used as control In cross	Human Amyloid β42 gene "Arctic"mutation In cross	Transgenic AD model Created by cross

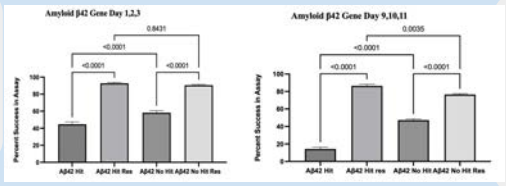
Results & Analysis

Resv= % Success p<.01



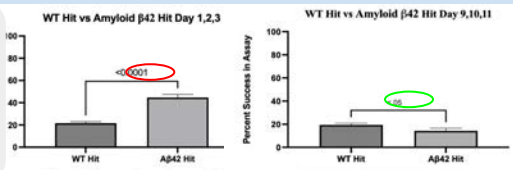
Resv Hit= % Success p<.01

Resve= % Success p<.01

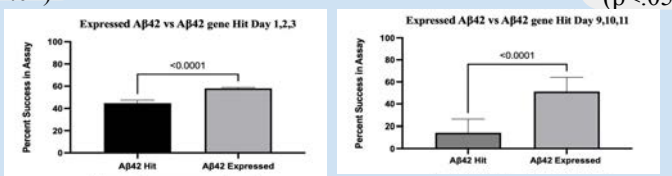


Resv Hit= % Success p<.01

Day 1,2,3 Aβ42 hit > WT hit (p<.01)



Day 9,10,11 Aβ42 hit < WT hit (p<.05)



Aβ42 gene hit flies < expressed Aβ42 flies → RHI likely expressed the gene

Conclusion & Future Research

Hypothesis #1 — Mostly Supported

Resveratrol = improving affect on Wild type and Amyloid β42 gene hit and no hit

Resveratrol = improving affect on Wild type and Amyloid β42 gene hit and no hit

Hypothesis #1 — Mostly Supported

Hit Amyloid β42 gene < Expressed Amyloid β42

Possibly indicating that RHI expresses the gene and makes symptoms more severe

Sam Potkin

Determining The Optimal Concentration Of Fe3O4 Nanoparticles In Water To Create A Liquid Coolant

Location of Research:
Harrison High School/Home

Mentor:
Dr. Silverman

WIll be Attending:
Carnegie Mellon

Intended Major:
Physics

Fairs & Awards:
WESEF 2024 - Ingenuity in Math, Physics, and Astronomy
Somers 2023 - 2nd Place Physical Sciences

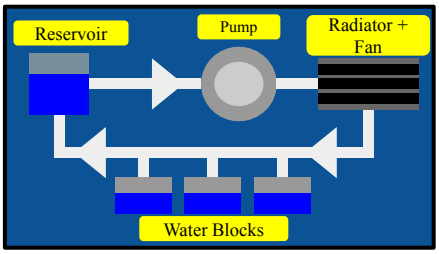
Suspensions of Fe3O4 (Iron Oxide) nanoparticles in water have a higher thermal conductivity than water, and increasing concentrations of iron oxide in the suspensions (tested up to 4%) increase the thermal conductivity further (Simpson, 2019). Thermal conductivity is the ability of a substance to transfer heat between another substance. This study seeks to answer what concentration of iron oxide provides the highest thermal conductivity. Personal computers require cooling systems to remove the heat produced as waste by operating the computer, as this heat can lead to malfunctions in the hardware or permanent damage. The personal computer business is a multi-billion dollar industry that is often at the forefront of innovation. More powerful and energy-demanding hardware is always being invented, which leads to higher working temperatures for computers, raising the importance of efficient cooling systems. This study seeks to build on the work of previous studies by testing further concentrations of iron oxide in water, the nanofluid supported to have the highest thermal conductivity of the ones tested. A dose response study was conducted to test for thermal conductivity using 5%, 6%, 7%, and 8% suspensions of Fe3O4 nanoparticles. Because the 4% suspension was most conductive, an additional more sustainable 4% suspension was created by oxidizing rusted iron waste in white vinegar. Vinegar's composition of 5-10% acetic acid results in the rust being removed from the waste, which consisted of nails, screws, and other recycled objects. Results revealed a significant difference in thermal conductivity between 4% and other concentrations, sans 7% which proved to be insignificant ($p<.05$). Whereas previous studies supported the idea of nanofluid thermal conductivity increasing with nanoparticle concentrations, this study concludes that increasing the concentration past 4% results in a decreased thermal conductivity.

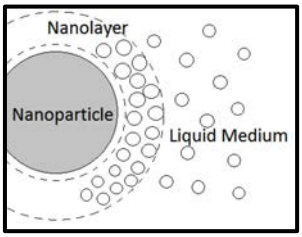
Determining The Optimal Concentration Of Fe3O4 Nanoparticles In Water To Create A Liquid Coolant

Introduction

Liquid Cooling: Use liquid to cool computers

Thermal Conductivity: To transfer heat





Nanofluids: Liquids with nanoparticles

Yoo et. al, 2006: Concentration → Thermal Conductivity

Simpson et. al, 2019: Fe_3O_4 thermally conductive

Iron Oxide was selected for this study

Problem

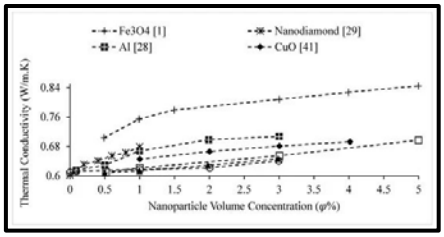
Computers require efficient cooling systems

Goal

Nanofluids as a liquid coolant

Hypothesis

Fe_3O_4 → Viable liquid coolant



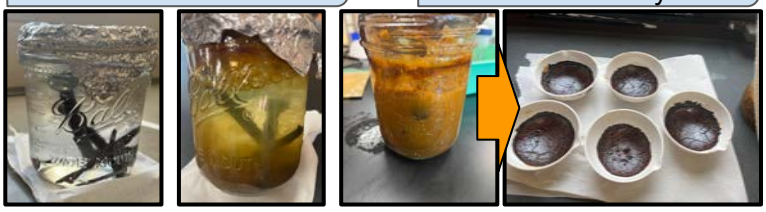
Methodology

Independent Variable

Concentration of Iron Oxide

Dependent Variable

Relative Thermal Conductivity



Nails were recycled, vinegar was purchased

Nails were placed in vinegar for one week

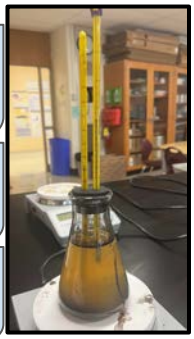
Drained, Evaporated, Scraped

Fe_3O_4 was bought in NP form

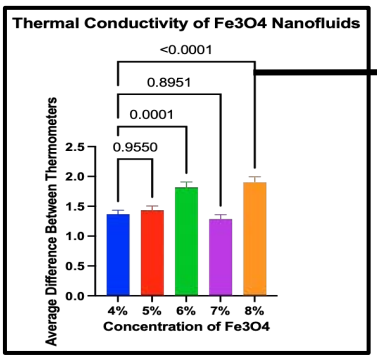
Sound waves suspended the particles

Each suspension was put on a hotplate

Difference between thermometers

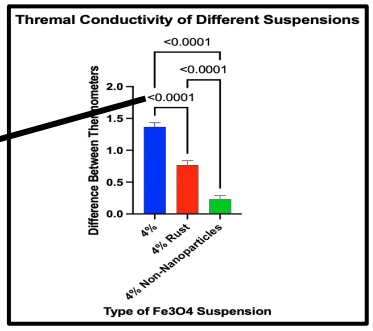


Results & Analysis



No relationship between concentration & thermal conductivity

Contradicts previous results



Rust-Recycled NP supported to have a higher thermal conductivity

Eco-friendliness

Flaws in methodology → Unexpected Results

Lack of Surfactants

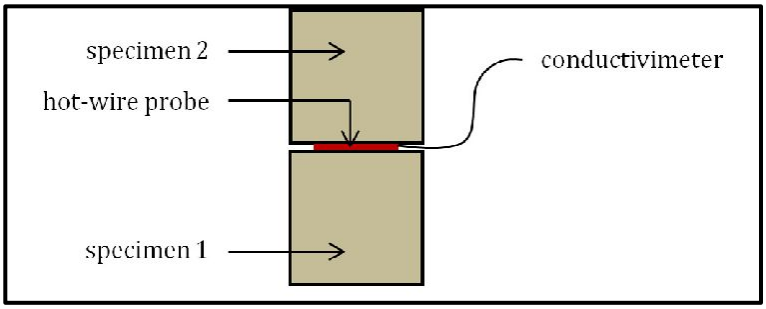
Stationary Flask

Nanoparticle Settling

Conclusion & Future Research

Thermal Conductivity not properly measured → Future Research is Required

Transient Hot-Wire Testing



Pros	Cons
Reliable Results	Expensive
Accurate	Hard to aquire
Nearly Instant	Difficult to use

Filippa Rasmussen

The Effect of Multiple Sessions of Evaluative Conditioning on Implicit Bias, Explicit Bias, and Consumption for Canned Great Northern White Beans

Location of Research:
Harrison High School

Mentor:
Ms. Allison Blunt

WIll be Attending:
Georgia Institute of Technology

Intended Major:
Chemical and Biomolecular Engineering

Fairs & Awards:
WESEF 2024 - 2nd Place in Behavioral Sciences
Upstate JSHS 2024 - 3rd Place in Behavioral Sciences
JSHS Regional 2023 - 2nd Place in Behavioral Sciences
WESEF 2023 - Honorable mention in Behavioral Sciences
Somers 2022 - 2nd place Behavioral Sciences
HHS Symposium - 2022, 2023, 2024

Almost one-third of the worldwide population has been diagnosed with iron deficiency anemia. Great Northern Beans (GNB) are an excellent source of iron because they do not have inhibitory polyphenols which results in a higher bioavailability. However, consumption of Great Northern beans has decreased 58% since 1970. Evaluative conditioning (EC) procedures are used to form or change attitudes toward an object. This study examined if the use of multiple trials of EC over a two week period could change implicit, explicit bias and consumption of GNB. Implicit associations test and the EC task were developed using Testable software. The EC task consisted of 25 trials of typing positive adjectives for food shown above a picture of GNB. The Implicit Association consisted of using images of GNB and other foods being categorized with positive and negative stimuli. Results showed there was a significant difference for both the frequency of consumption and the amount consumed for the experimental group ($p<.05$) but not the control group. There was no significant difference between the implicit bias for the experimental group before and after the EC task ($p<.05$) However, the implicit bias changed from negative to positive for the experimental group. Although not significant, the relative change in explicit preference after completing the EC task was higher in the experimental group. These findings suggest that pairing GNB with positive stimuli can have behavioral effects toward GNB. Future research would examine whether results can be generalized to other foods.

The Effect of Multiple Sessions of Evaluative Conditioning on Implicit Bias, Explicit Bias, and Consumption for Canned Great Northern White Beans

Introduction

Iron Deficiency

- About one-third of population has iron deficiency anemia (Kumar, 2022)
- Dietary Iron intake has decreased 6.6 % while anemia decreased between 10.5% - 106% depending on age and sex (Sun, 2021)

Great Northern Beans (GNB)

- Iron from most beans has low iron bioavailability because of seed coat polyphenols (Petry, 2010)
- GNB don't have the inhibitory seed coat polyphenols
- However, Consumption of GNB fell 58% since 1970 (U.S. Department of Agriculture, 2017)

Evaluative Conditioning (EC)

EC is the attitude formation caused by an object's pairing with positively or negatively valenced stimuli

Review of Literature

Hensels, 2016 → Single EC session altered implicit food evaluations but did not alter explicit food choice

Lawrence, 2015 → Multiple sessions of response inhibition caused significant change in attitude & behavior

Methodology

Evaluative Conditioning Task

- Participants typed the word shown above the picture of GNB (25 times)
- Completed 8 sessions in 2 weeks

Implicit Bias - Implicit Associations Test (IAT)

- Implicit Bias is measured with indirect methods
- IAT Measures accuracy and time taken to respond

Explicit Bias

Measured with traditional self-report scales

Explicit Bias 1

Forced choice task (required to select if they would eat GNB)

Explicit Bias 2

Choice out of 6 recipes of GNB

Consumption

GNB Frequency Questionnaire

Scale rating # of times GNB consumed previous week

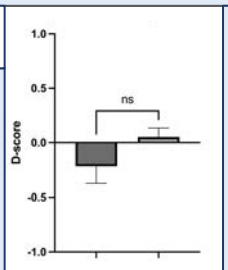
Taste & Consumption Test

Participants rate questions about the taste and enjoyment to see how many grams of GNB were consumed

Results & Analysis

Implicit Bias

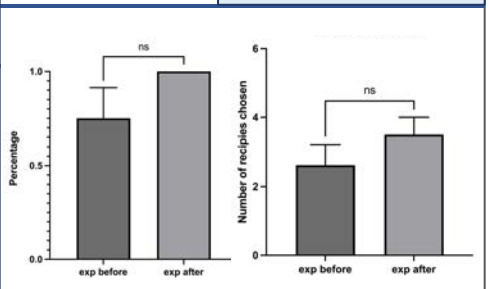
For experimental group (Not significant)



Implicit Bias changed from negative to positive for GNB

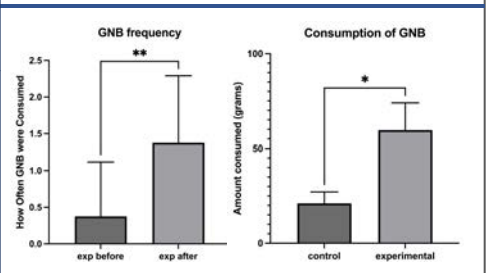
Explicit Bias

For experimental group (Not significant)



Consumption

Significantly for experimental group



Conclusion & Future Research

Discussion

- EC condition consumed significantly more GNB
- Although not significant, implicit bias of EC changed from a negative to a positive correlation and all participants after completing 8 EC session selected they would choose to eat GNB

Future Research

- Larger / more diverse sample size
- Test different # of EC sessions
- Take measures after experiment over time
- Explore if EC can be used as a method to expand diet of picky eaters

Conclusion

Dwyer, 2007; Hollands, 2011, Hofmann, 2010 → Significant change in the participants' bias (attitudes) but not consumption (behavior)

Does not agree with

Current Study → Significant change in consumption (behavior) but not bias (attitudes)

Alissa Remeza

Using an Original Visual Approach to Evaluate DUNE Convolutional Neural Network Identification Biases for Accurate Measurements of Neutrino Oscillations

Location of Research:
Brookhaven National Laboratory / Remote

Mentor:
Dr. Mary Bishai, Dr. Nitish Nayak

WIll be Attending:
Brown University

Intended Major:
Engineering

Fairs & Awards:
WESEF 2024 - *1st Place Physics & Astronomy*
NYSSEF 2024 - *2nd Place Physics & Astronomy*
ISEF 2023 - *CIA Award, Finalist*
WESEF 2023 - *Finalist, 2nd Place Physics*
NYSSEF 2023 - *2nd Place Physics & Astronomy*
Somers 2022 - *2nd Place Physics & Astronomy*
HHS Symposium - 2022, 2023, 2024

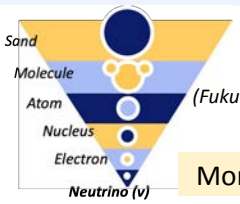
The Deep Underground Neutrino Experiment (DUNE) fields next-generation technologies to observe charge-parity violation of neutrinos, fundamental particles plausibly informing the degree of matter dominance to justify currently unsupported, major theories within Big Bang cosmology. However, the black box convolutional visual network (CVN) applied by DUNE to reconstruct neutrino events for analysis was unvetted for discrepant behavior. This study ensured accurate DUNE analysis by identifying biasing and sensitive factors within the CVN image processing program. A novel methodology was implemented to modify neutrino event shower components and final state particle momentum manually. Overarching factors were tested through image wire-axis reflections and input view removals for an 800-event sample. Results indicated disproportionate CVN error for the collection view of the event input and deep inelastic neutrino events, with significantly increased erroneous predictions at 5.5σ ($p << 0.01$) and 4.9σ ($p << 0.01$), respectively. CVN correct scores decreased on average 86% for event shower removal and 55% in the collection plane alone. Shower stem removal resulted in a shift from 0% to 78% errors within the dataset. Momentum manipulations resulted in 75% CVN erroneous predictions within the sample. Results indicate a potential bias in CVN momentum training as well as collection plane overreliance concomitant with insufficient network training. The results highlight improvements to be addressed to obtain accurate neutrino oscillation data for DUNE.

Using an Original Visual Approach to Evaluate DUNE Convolutional Neural Network Identification Biases for Accurate Measurements of Neutrino Oscillations

Title

Introduction

Neutrinos (ν) in the Standard Model (SM)



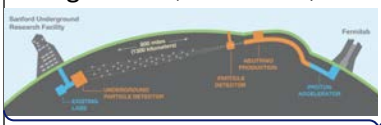
νs: least massive particle in the universe *(Fermi National Accelerator Laboratory, n.d.)*

(Fukuda et al., 1998) Oscillations between ν flavors (types) demonstrate **anomalous** ν mass

More observation informs a new SM level

The Deep Underground ν Experiment (DUNE)

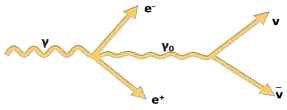
International collaboration, fields next-gen tech *(Abi et al., 2020)*



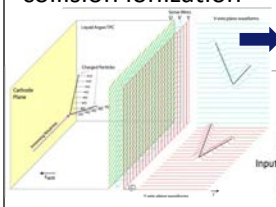
ν Detection

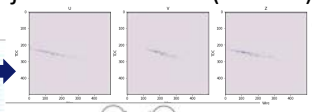
Difficult: weak, electrically neutral, nearly massless

- Only visible upon collision

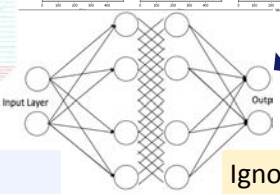


Liquid argon time projection chamber (LArTPC) reconstructs collision ionization





Classify ν type - *Use neural net (CVN)*



Mimics brain function - Self trained

CVN Black Box

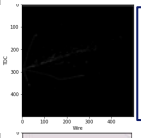
Ignores physical laws

Methodology

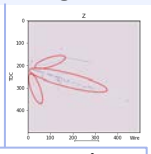
Purpose

Identify DUNE CVN biases, combining human-AI strengths

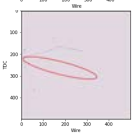
Hand Manipulation Structure



800 Event Sample
Human intuition: Identify standout PNG features

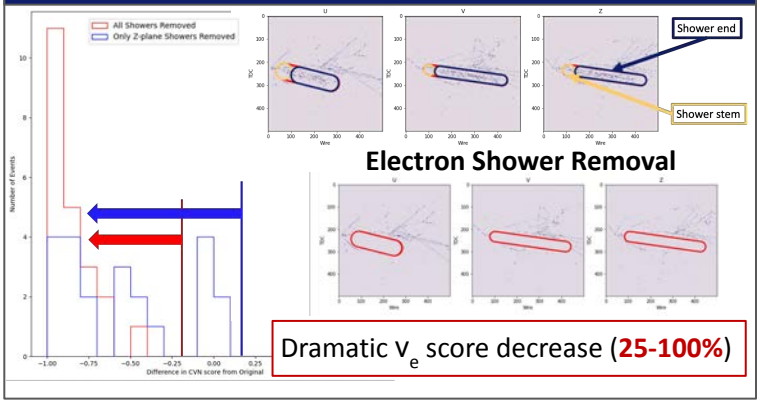


Manually remove sections
Manipulate main activity



Evaluate effect on network
Human perspective addresses trends, biases

Results



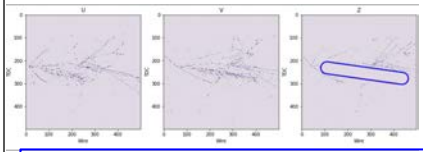
Electron Shower Removal

Dramatic ν_e score decrease (**25-100%**)

Results (Continued) & Analysis

(**100% errors**) ⟶ CVN heavily shower-reliant *(key ν_e trait)*

Collection Plane Shower Removal

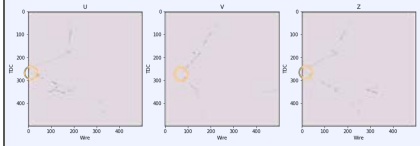


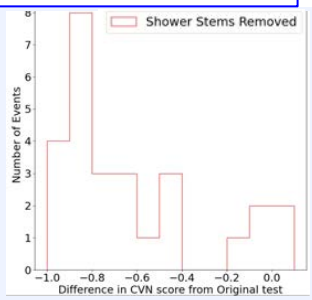
Substantial CC ν_e score decrease (**0-100%**)

- 13/22 flavor errors

CVN on collection plane shower *(LArTPC prominence)*

Shower Stem Removal

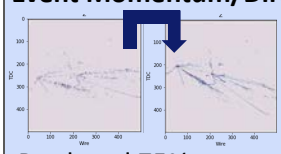




23/27 events >40% %ν_e decrease

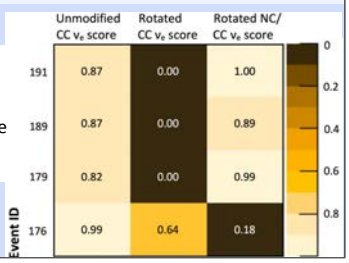
- *I.e.,* 78% errors; *Electron-photon discrimination issue*

Event Momentum/Directionality



Average 73% CC ν_e decrease

Produced 75% errors ⟶ no scientific basis

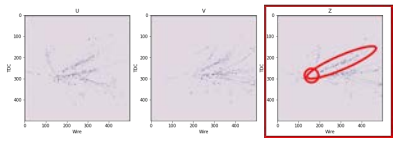


Discussion & Future Research

Sensitivity identification: ✓; key biases, reveals black box

Overwhelming sensitivity to:

Collection Plane *(5.5σ)* ⟶ Shower *(100% error)* ⟶ Stem *(78% error)*



Event Momentum

Key biasing factor, no basis ⟶ merits testing, CVN flags

Concurrent Result: NOvA Saliency *(Shmakov et al., 2023)*

Mathematical method, validates e^-/photon discrimination

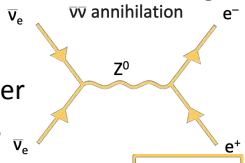
Fails to address stem relevance, momentum angle

-- *supports novel human-based visual approach*

Implications: Machine Learning Intervention

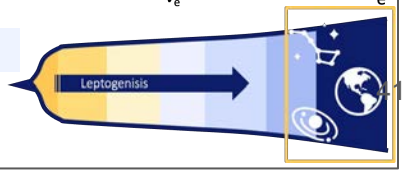
Precedential use of human intervention in machine learning; Capitalizes on AI efficiency, human vision

Majorana ν Expression: Matter-antimatter equivalence ⟶ explains Big Bang universe



Grand Unified Theory (GUT)

Majorana suggests mass seesaw at GUT masses



Mako Suzuki

The Extent to Which Blue Light Glasses Mitigate the Effect of Blue Light on Blink and Pupil Reflex

Location of Research:
Harrison High School

Mentor:
Ms. Allison Blunt/Dr. Christopher Tyler

WIll be Attending:
New York University

Intended Major:
Biochemistry

Fairs & Awards:
WESEF 2024 - 3rd Place Medicine & Health
WESEF 2023 - 3rd Place Medicine & Health
NYSSEF 2023 - 3rd Place Medicine & Health
JSHS 2023 - Regional Speaker
STS 2023 - Applicant
Somers 2022 - 1st Place Medicine and Health
HHS Symposium: 2022, 2023. 2024

With increased exposure to screen time, there are rising concerns about blue light's impact on eye health. Blue light is said to contribute to eye strain, which is caused by reduced blinking. Blue light glasses are marketed to filter out light to mitigate eye strain, but there is controversy as to whether they work. A proof of concept study was conducted to determine whether measurement of blinking rate was an effective assessment of blue light glasses' ability to mitigate eye strain. The study found an increased trend in blinking rate while wearing blue light glasses when looking at a blank screen and writing a transcription; a significantly increased trend was revealed when reading a passage and watching a video ($p<.05$). An experimental study confirmed these trends using a repeated measure design, although there was no significance ($p>.05$). In addition, it was found that blue light glasses promoted significantly positive change in pupil size for watching a video and reading ($p<.05$). Meaning, blue light glasses may effectively reduce pupil constriction caused by blue light. These results imply that there could be a specific receptor pathway that blue light follows that controls these neurological reflexes. More research needs to be done, but the implications were that blue light glasses can possibly be used as a preventive tool for those exposed to prolonged screen use.

The Extent to Which Blue Light Glasses Mitigate the Effect of Blue Light on Blink and Pupil Reflex

Introduction

Blue Light:

- Color on the visible spectrum with ↑ energy and ↓ **wavelength**
- ↑ light scattering - potential link to eye strain (ES)

Blue Light Glasses (BG):

- Marketed to ↓ ES
- Unclear mechanism

Previous Research 2023 -

- Blinking rate (BR) - maintain stable tear film
- BG significantly ↑ BR when reading a passage and watching a video
- Possible mechanism: protects corneal surface through eye lubrication
- Specific receptor pathway may affect neurological control of blink and pupil reflex

Observe another neurological reflex associated with ES: pupillary
- ↓ pupil constriction ↓ glare, another symptom of ES

Hypothesis:
BG will increase BR and reduce pupil constriction

Methodology

Independent

BG vs. Placebo

Activities:
A. Looking at a Blank Screen
B. Reading a Passage
C. Writing a Transcription
D. Watching a Video

Brightness Level (BL):
6 bars
12 bars

Dependent

# of blinks/min. (BR)
Each activity performed at each BL for 1 minute

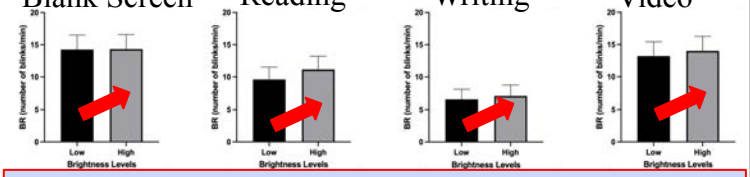
Change in Pupil Size (CPS) at the beginning and end of a minute interval

Control

- Position of the computer
- Distance to the computer
- Illuminance from the screen
- Consistent light source

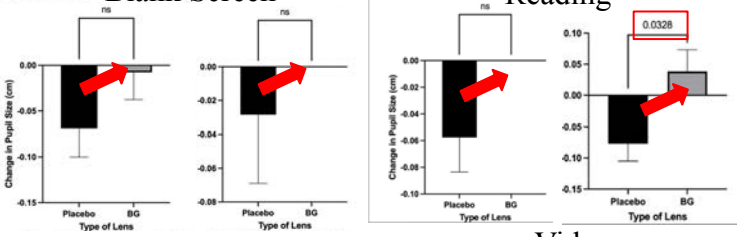
Results and Analysis

Blank Screen | Reading | Writing | Video

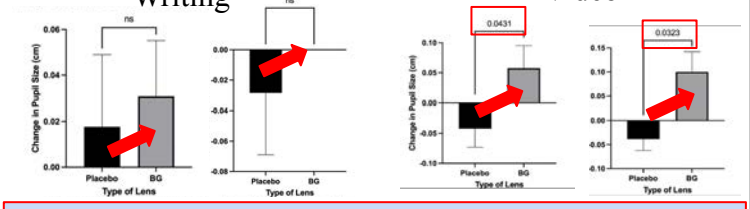


BG ↑ BR across all activities, although not significant

Blank Screen | Reading



Writing | Video



BG produced + CPS = ↓ pupil constriction

Conclusion & Future Research

Hypothesis somewhat supported

BG did not significantly ↑ BR when using a repeated measure
but
BG significantly produced + **CPS** when reading a passage and writing a video = ↓ **pupil constriction**

Compared to Suzuki 2023

Pupillary → significance when reading a passage and watching a video

Trend for BR found in Suzuki 2023 found significance for the **same activities**

Blue light affects blink and pupil reflex in a similar way = similar/same neurological pathway

Limitations	Further Research
-Time/control restrains -Limited sample -Can't physically observe neurological reflexes	-Observe inflammation from blue light exposure through GFP reporter for cell death

Danielle Topper

Evaluating Gene Linkages through Pathway Analysis in Alzheimer's Disease

Location of Research:
Home/HHS/UNC

Mentors:
Dr. Ben Bahr (UNC Pembroke) &
Dr. Silvia Smith (UNC Pembroke)

Will be Attending:
Vanderbilt University

Intended Major:
Biomedical Engineering

Fairs & Awards:
JSHS 2024 - Participant
IDEAS Forum 2023 - Pre-college Presenter
Regeneron 2023 - Science Talent Search Applicant
Alzheimer's Disease Symposium at Duke/UNC 2023 - Guest Presenter
WESEF 2023 - Innovations in Biological Sciences Research Award
Somers 2022 - 1st Place in Bioinformatics
HHS Symposium - 2022, 2023, 2024

This study evaluated the role of the lysosomal pathway in Alzheimer's disease (AD). Investigations of AD are important in the scientific world because the disease is highly common and is even fatal. To evaluate the lysosomal degradation pathway's implications in AD, this study utilized in-silico analysis. A set of molecules was identified through extensive literature searches of peer-reviewed articles to form a molecules of interest list. These categories included molecules pertaining to AD, the lysosome, or both AD and the lysosome. The software QIAGEN IPA(R) was used to generate results for this study once the molecules of interest were inputted into the database. Key findings from the analysis support the role of the cathepsin enzymes as key players in the lysosomal pathway and AD. Trends seen in the produced results support the relation among cathepsin B, cathepsin S, cathepsin L, and cathepsin D and other molecules in the data set. Findings were statistically supported by statistical tests performed by QIAGEN IPA(R) and their respective p-values. In conclusion, results support that the initial set of molecules are mostly connected and implicated within the lysosomal pathway. This is important in the general study of Alzheimer's disease because it points to the lysosome as a key player in the disease.

Evaluating Gene Linkages through Pathway Analysis in Alzheimer's Disease

Dani Topper

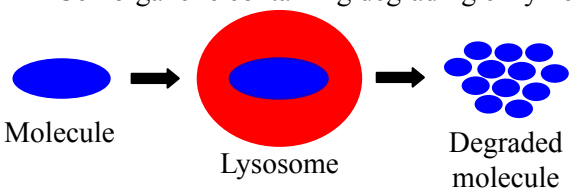
Introduction

Alzheimer's Disease (AD)

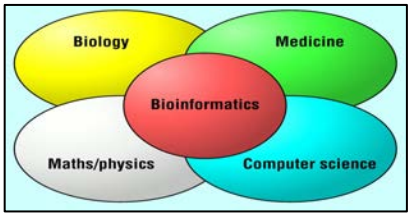
- Disease impacting memory/motor ability
- Commonly caused by plaque formation (combated with lysosomal activity)

Lysosome

- Cell organelle containing degrading enzymes



Bioinformatics

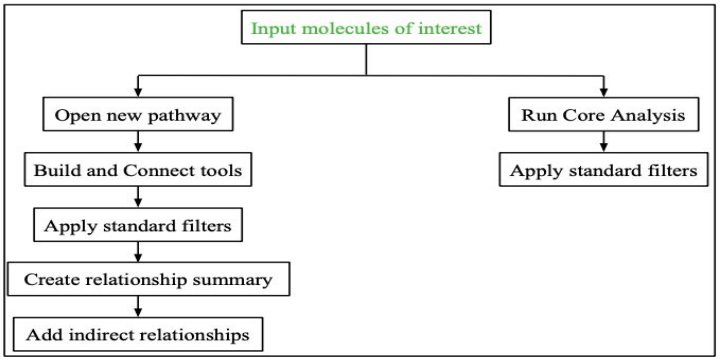


-Contextualizes molecule relationships
-Pre-existing & peer-reviewed
-Large sample size

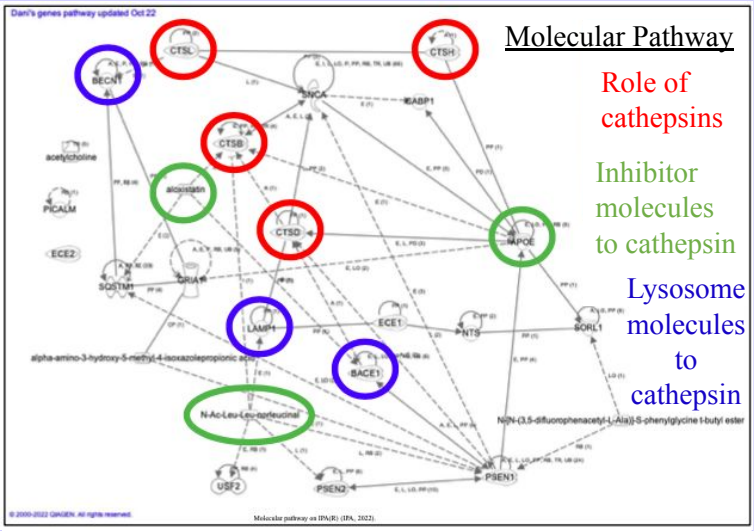
Methodology

- ➔ Literature search (Google Scholar, PubMed)
- ➔ Formulate molecules of interest list
- ➔ *In-silico* analysis in QIAGEN IPA
- ➔ Analyze results and explain findings

Molecules of Interest: acetylcholine, Aloxistatin, alpha-amino-3-hydroxy-5-methyl-4-isoxazolepropionic acid, APOE, BACE1, BECN1, CABP1, CTSB, CTSD, CTSH, CTSL, ECE1, ECE2, GRIA1,LAMP1, N-[N-(3,5-difluorophenacetyl -L-Ala)]-S-phenylglycine t-butyl ester, N-Ac-Leu-Leu-norleu -cinal, NTS, PICALM, PSEN1, PSEN2, SNCA, SORL1, USF2



Results & Analysis

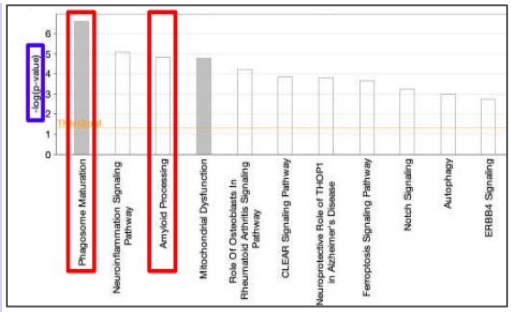


Molecular Pathway

Role of cathepsins

Inhibitor molecules to cathepsin

Lysosome molecules to cathepsin



Canonical Pathway

phagosome maturation & amyloid processing pathways are largely implicated

Conclusions & Future Research

Hypothesis

The genes identified from various peer-reviewed articles are implicated in the lysosomal pathway in Alzheimer's disease.

Evaluations

- Small data set (only 24 molecules)
- Limitations of database studies project onto limitations of this study
  - Model organisms vs. humans
- Peer-reviewed literature, $p < 0.05$ for results

➔ Lysosomal implication in Alzheimer's

➔ Drugs, treatments, therapies for Alzheimer's

➔ New pathways for investigation

Vanderbilt University
School of Engineering

Future Research:
Understand implication of Alzheimer's Disease in Biomedical Engineering

Alec Udell

An Investigation of Hydrolytic Degradability of Biodegradable Plastic Products in Natural Aquatic Conditions

Location of Research:
HHS/Manhattan College

Mentor:
Dr. Ashlee Jahnke, Texas A&M University

Will be Attending:
Duke University

Intended Major:
Environmental Science

Fairs & Awards:
Upstate JSHS 2024 - 1st Place Environmental Science, 2nd Place, National Qualifier
Regional JSHS 2024 - 1st Place Environmental Science
WESEF 2024 - 2nd Place Environmental Science
Regeneron STS 2024 - Applicant
Somers 2023 - 2nd Place Chemistry
HHS Symposium - 2023, 2024

Annually, 10 to 12 tons of plastic lures (PLs) are lost in the world's oceans. Fishing lures are objects that attract predatory fish by resembling baitfish. In oceans, PLs break down into microplastics, releasing toxic chemicals like phthalates that harm marine species by causing oxidative damage or abnormal behavior. Biodegradation occurs when a polymer decomposes into carbon, hydrogen, and oxygen by microorganisms, and hydrolytic degradation facilitates this process. In response to heightened awareness of water pollution, companies have tested the degradation of biodegradable plastic lures (BPLs) in controlled lab settings, however, few studies have measured BPLs' biodegradability in natural environments. Therefore, the purpose of this study was to determine the extent of biodegradability of different polymers in natural aquatic conditions. Polymers advertised as biodegradable including polyhydroxyalkanoates (Phade Straws), polylactic acid (Eco Cups), thermoplastic elastomer (Z-man BPLs), and water-soluble polymers (Berkley Gulp! BPLs) were exposed to average, high, and low temperatures, salinity, UV, and pH ocean levels over a 12-week period; change in mass was measured weekly. Masses were normalized through relative mass remaining each week. Fourier Transform Infrared (FTIR) spectroscopy revealed that additives leached from BPL samples, shown by peaks ~2900 cm-1. Peaks ~1700 cm-1 for Phade and PLA samples indicate ester degradation. Under the conditions tested, no samples met the benchmarks in biodegradability claims of ASTM D6400, the USA biodegradability standard, over the 12 weeks. This suggests that BPLs, while they meet industrial standards, do not translate to natural marine environments and alternatives are needed to combat marine litter.

An Investigation of Hydrolytic Degradability of Biodegradable Plastic Products in Natural Aquatic Conditions

Alec Udell

Introduction

Biodegradable plastic on a beach (UN Environmental, 2016)

Fishing lure made of Polyvinyl Chloride (PVC) - oil resin (Salt Strong, 2023)

Ghost Gear: Lost or Discarded Fishing Gear

>10% ***All*** Marine Litter (WWF, 2023)

10-12 Tons of Annual Lure Pollution (Durkin, 2018)

Hydrolytic Degradation: Degradation mechanism where polymer chains react with water molecules and breaks into smaller chains.

ASTM D6400 → <10% of fragments larger than 2 mm diameter after a **12-week period** (Silva et al., 2023)

Methodology

Samples

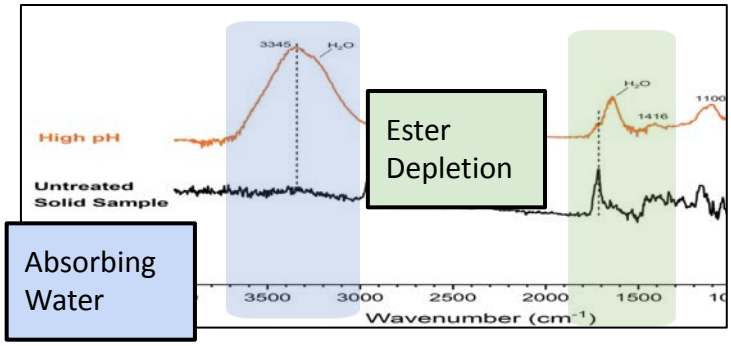
Z-man | Gulp | Phade | Eco | Birchware

'Biodegradable' Lures (Ceran, 2023)	'Biodegradable' Products (Nielsen, 2023)	Control (Birchware, 2023)

(NOAA, 2023) **Oceanic Treatments Matrix**

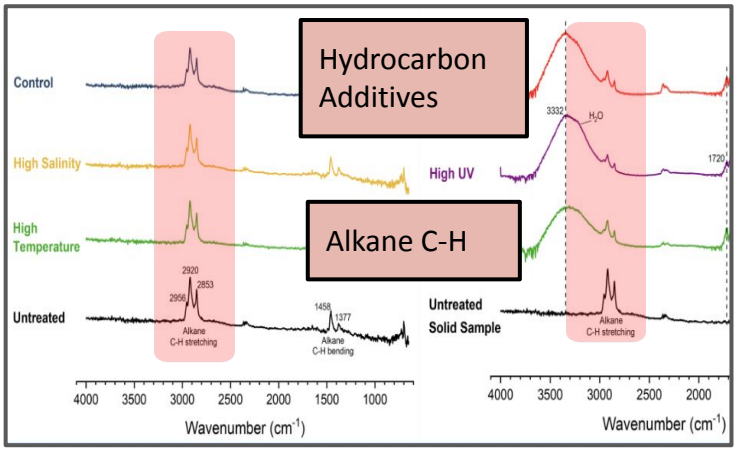
	Temp	Salinity	UV	pH
Temp (°C)	High: 33.2 Low: 3.3	22.0	22.0	22.0
Salinity (ppt)	35	High: 38 Low: 33	35	35
UV	No exposure	No exposure	60 Hz 120 V	No exposure
pH	8.3	8.3	8.3	High:14 Low:1

Results & Analysis



Ester Depletion

Absorbing Water



Hydrocarbon Additives

Alkane C-H

Conclusion & Future Research

Limitation: Instant Ocean → Future: **BSL2**

Mold Formation → Limited Microbe Presence

New Standards → Natural Conditions

95% Confidence Intervals For Degradation

Z-man Sample: **3-40 years** → **0.3 g 12.7 g** → Z-man Lure: **116-1483 years**

Alexandra Wong

Pathogenesis of CAG Repeat Disorders Modeled in Fibroblasts from DRPLA and HD Patients

Location of Research:
Weill Cornell Medicine

Mentor:
Dr. Rajiv Dixit

WIll be Attending:
University of Pennsylvania

Intended Major:
Health and Societies

Fairs & Awards:
WESEF 2023 - 3rd Place Neuroscience
NYSSEF 2023 - Honorable Mention Cellular and Molecular Biology
JSHS 2024 - Participant
WESEF 2024 - Participant
HHS Symposium: 2022, 2023.2024

Neurodegenerative diseases (ND) are characterized by the irreversible loss of susceptible neurons of the brain and spinal cord. Dentatorubural-Pallidoluysian Atrophy (DRPLA) is a rare autosomal dominant neurodegenerative disease caused by the expansion of trinucleotide CAG repeats encoding poly-glutamine (PolyQ) tracts in the Atrophin1 gene. Research has reported the involvement of mitochondrial dysregulation and oxidative stress in child- and adult-onset neurological diseases like Huntington's Disease (HD). As new therapies are being developed, it is worthwhile to understand if the abnormalities of mitochondrial bioenergetics characterized by reactive oxygen species (ROS) overproduction seen in HD and DRPLA patient neurons are evident in fibroblasts. To investigate oxidative stress and mitochondrial alterations, different methods were used to investigate ROS parameters in conjunction with mitochondrial dysfunction. Increased mitochondrial morphological changes in diseased samples in DRPLA and HD lines compared to control lines. Using MitoSox and DHE, levels of both mitochondrial superoxide and cytosolic ROS have been noticed in both HD and DRPLA fibroblast lines. We further confirmed the significantly elevated levels of ROS using a nonfluorescent Nitroblue Tetrazolium (NBT) in diseased PolyQ samples. Fibroblasts were also tested for their ability to recapitulate gene expression similar to those observed in neuronal cells. In this pilot study, fibroblasts were successful in their amplification with gene primers. Thus, it is proposed that patient-derived fibroblasts can be established as a model system in identifying novel biomarkers of PolyQ that recapitulate in neuronal cells, including alterations in mitochondria and oxidative stress.

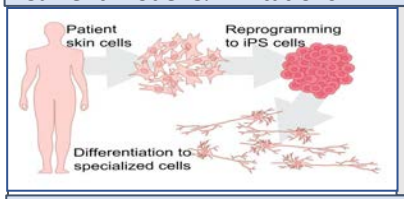
Pathogenesis of CAG Repeat Disorders: Modeled in Fibroblasts from DRPLA and HD Patients

Introduction

Neurodegenerative Diseases (NDs) affect ~15% of worldwide population

- Brain has largely separate blood supply
- NDs difficult to diagnose unless knowledge of inheritance

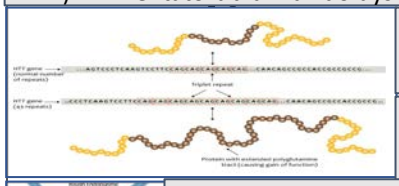
Current Model & Limitations



Problems with current model:
1.Time
2.Cost
3.Quality

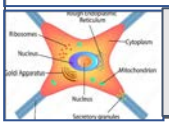
Polyglutamine (PolyQ) Diseases:

1) Huntington's Disease (HD)
2) Dentatorubral-Pallidoluysian Atrophy (DRPLA)



Triple cytosine adenine guanine (CAG) repeat

Expanded PolyQ tract to misfolded protein



- Same DNA with simplified cell structure
- Easier to obtain
- Easier to keep in culture

Methodology

Independent Variable - Fibroblast Lines

Controls	DRPLA	HD
S1 S2	DRP-003 DRP-040	HD-066

Dependent Variables - Assays

2023

- MitoTracker
- MitoSox
- NitroBlue Tetrazolium
- Dihydroethidium

2024

- MitoTracker
- MitoSox
- qPCR

Controls - Fibroblast Cultures

- Mentor provided from research center, NY
- Cultured monolayers in T75 flasks, passaged at 75-80%

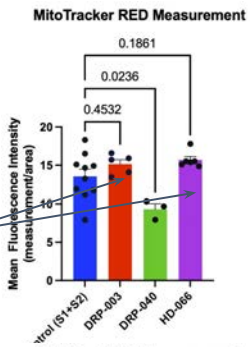
Hypothesis

Overlap between features of DRPLA and HD patient derived fibroblasts will identify key drivers of pathogenic pathways common to PolyQ disorders.

Results & Analysis

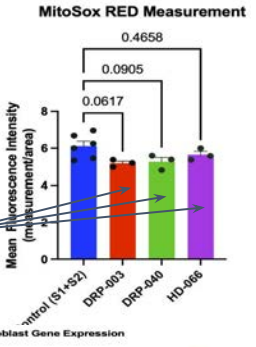
MitoTracker:
-Mitochondrial indicator by MitoTracker® Red CMXROS localizes in the actively respiring mitochondria

Increased number of mitochondria in diseased cells to compensate for energy deficits

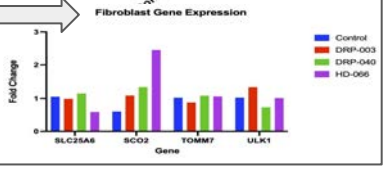


MitoSox:
-Mitochondrial superoxide indicator
-Detects cellular ROS that accumulates in mitochondria from positive charge of probe fluorescence identity

Similar ROS levels among diseased cell lines



Insignificant change between expression in diseased lines compared to control



Inconsistent pattern between diseased cell lines

Conclusion & Future Research

Hypothesis somewhat supported

- HD and DRPLA Fibroblasts indicate similar characteristics from MitoTracker and MitoSox
- Fibroblasts results lack consistency in PCR

Overlap between DRPLA and HD features → diseased fibroblasts have ability to be used for tests regarding mitochondrial characteristics

Inconsistency by PCR → fibroblasts may have different gene expression from neurons

Limitations

MitoTracker & MitoSox
- Lack of baseline to measure fluorescences
- Necessary to remove data bleached by fluorescences

PCR
- Limited number of genes used for assay

Propose human-derived fibroblasts to be used as a disease model in particularly NDs and PolyQ disorders

Ines Xhayet

The Identification of Target Genes for Chronic Pain along Ion Channels in *Drosophila melanogaster*

Location of Research:
HHS

Mentor:
Dr. Cale Whitworth, BDSC

WIll be Attending:
Georgia Institute of Technology

Intended Major:
Chemical and Biomolecular Engineering

Fairs & Awards:
JSHS Speaker 2024, Medicine & Health
Somers 2023, Medicine & Health Sciences
HHS Symposium 2023, 2024

Nociception is the ability to sense pain. Chronic pain is an adaptive response to noxious stimuli that cause tissue injury or have the potential to cause injury and lasts for longer than 12 weeks despite medication or treatment. Though some research supports the idea that ion channels, specifically sodium and calcium channels, may play a role in the pain pathway, limited target genes have been identified. The purpose of this study was to validate *Drosophila melanogaster* as a valid model for chronic pain, as well as test the role ion channels have in the chronic pain pathway. Specifically, *Drosophila melanogaster* that had mutated Dh-31R genes were targeted because of its association with the pain pathway in humans; mutated para genes were used because they generate sodium dependent action potentials, and Hsc70-3 genes were used because they regulate Calcium ion channels. A hot plate assay was conducted because it was already established as a method to studying nociception. A significantly fewer percentage of the mutated flies did not react to heat stimuli in comparison to the wildtype ($p<0.0001$). The Dh31-R reacted the least to the heat stimuli which validated *Drosophila melanogaster* as a model for chronic pain. The *para* gene along the sodium channel responded significantly less to the heat stimuli than the Hsc70-3 gene along the calcium channel ($p<0.0001$). Implications include that drugs targeting these genes could be efficient in managing chronic pain in humans.

The Identification of Target Genes for Chronic Pain along Ion Channels in *Drosophila melanogaster*

Introduction

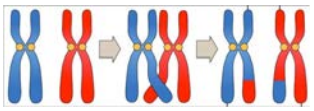
•**Chronic pain** : a pain that lasts longer than 12 weeks, regardless of treating or medication

•Affects **20.4%** of US adult population

•**Negative psychological effects**: anxiety, depression, trouble sleeping …

•**Current treatment** :antidepressants, non-steroidal anti-inflammatory drugs…BUT **negative side effects**

•***Drosophila melanogaster*** : a valid model



FLY A FLY B CROSS OFFSPRING

•**Previous research:**

- Discovery of first *Drosophila melanogaster* pain gene

-Drastic changes in sodium channels in chronic inflammatory or neuropathic conditions

Role in transmitter release = target in preventing sensory transmission

•**Hypothesis:** Genes along calcium and sodium channels will have a weakened response when exposed to heat stimuli

Methodology

Genes Studied

Dh31-R	• Ortholog for CGRP gene in humans • CGRP validated as gene along chronic pain pathway in humans
para	• Encodes an α-subunit of voltage-gated Na channels • Required for generation of Na -dependent action potentials
Hsc70	• Located along calcium channel • Plays role in endoplasmic reticulum →regulates Ca channels
elav GAL4	• Method used to study gene expression • Direct the expression of a gene of interest to a specific tissue

Procedure

Female virgins → Mate w/ male GAL4 → Cross flies

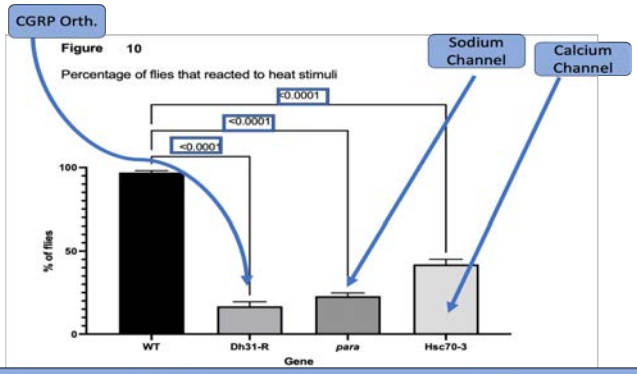
 → Remove adults → Perform hot plate assay

Independent Variable
- Dh31-R, *para*, Hsc70 genes

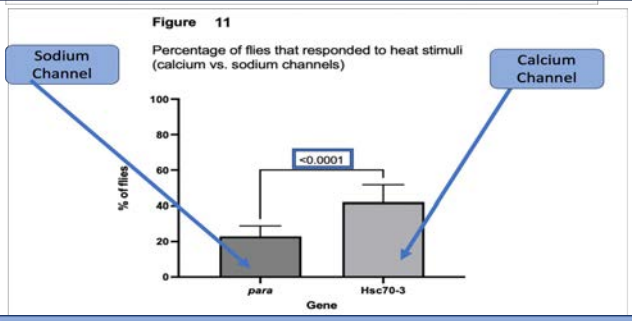
Dependent Variable
- # of flies on roof of dish

Controls
- Time in water
- Temperature (air and water)
- Size/type of dish

Results & Analysis



Significance diff. between independent variables and wildtype



Significance diff. between calcium and ion channels

Conclusion & Future Research

Drosophila melanogaster = **valid model** for **chronic pain**

Insight about sodium and calcium channels

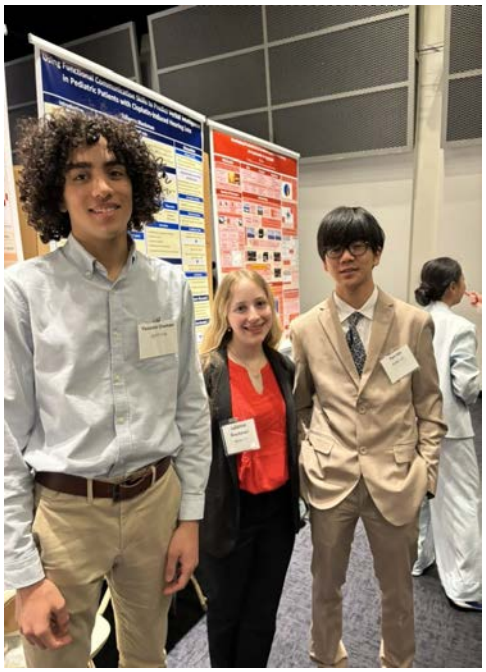
Allows for new possible **drug targets**

***HYPOTHESIS SUPPORTED ✅**

•**FUTURE RESEARCH:**

- Look at **mechanistic roles** of sodium and calcium channels in chronic pain pathway
  - RNA sequencing
  - histochemistry
- does gender affect the genes chosen?
- males vs. females

Science Research Juniors



Remi Badner

How the Amount of Time Spent on Social Media Affects the Reported Frequency of Cognitive Distortions

Mentor:
Ms. Allison Blunt
HHS

Teenagers can spend upwards of 5 hours per day on social media and the effects on their mental health are somewhat unknown. Cognitive distortions are irrational patterns of thinking that distort a person's perception of reality and lead to negative emotions. These negative thought patterns can lead to anxiety, depression and lowered self-esteem. Covin (2011) found that college students reported increased frequency of mind reading, emotional reasoning, personalization and minimizing the positive in social situations. Given that social media can be used in many friendship promoting ways, and that social people are active both on- and offline, it is unclear if adolescents experience similar cognitive distortions while on social media as in social situations. The purpose of this study was to determine how the amount of time spent on social media affected the reported frequency of cognitive distortions in teens. 108 adolescents were surveyed using an adapted version of Covin's (2011) The Types of Thinking Scale for social media situations. Results showed that similar to Covin's findings for social situations, mindreading was experienced significantly more frequently than other cognitive distortions ($p<.05$), although, unlike Covin (2011), should statements were reported more frequently than other cognitive distortions.Overall females reported a significantly higher frequency of cognitive distortions while on social media than males ($p<.01$). However, as the amount of time spent on social media increased, there was no significant change in the reported frequency of cognitive distortions, and surprisingly, many times, there was a slightly inverse relationship. Implications include that increased time spent on social media may actually point to prosocial behaviors and fewer reported cognitive distortions, meaning that negative thought patterns may keep adolescents off social media rather than engaging with it.

Julianna Blackman

Using Functional Communication Skills to Predict Verbal Intelligence in Pediatric Patients with Cisplatin-Induced Hearing Loss

Mentor:
Dr. Melissa Balderrama
Children's Hospital,
Los Angeles

Cisplatin is a chemotherapy drug used to treat various types of cancer. Cisplatin, however, can cause ototoxicity, or damage to the ears, resulting in sensorineural hearing loss. Hearing loss has major effects on quality of life and is found to impact several neurocognitive domains. This study researched whether functional communication scores could be used to predict crystalized verbal intelligence (CVI) in children with cisplatin-induced hearing loss (CIHL). Functional communication measures a patient's ability to share feelings and basic needs effectively, and hearing ability likely plays a large role in the skill's development. CVI refers to accumulation of knowledge and skills through written and spoken language. Deficiencies in this area can cause difficulties in patients' academic, social, and professional lives. Patient chart data from a Western U.S. urban Children's Hospital was mined for hearing evaluation results, neuropsychological testing scores, and demographic information. A hierarchical multiple regression was employed using two models. The first model included age at cancer diagnosis, amount of cisplatin received, amount of radiation therapy to the brain, and socioeconomic status (SES), which was determined by median income within the patient's zip code. This model explained 51% of the variance, $F(4, 19) = 4.952$, $p = .007$. The second model added functional communication and explained 55.2% of the variance, $F(5, 18) = 4.432$, $p = .008$. In the second model, only SES was significant (significance level <.001), while functional communication had a significance level of .214. A correlation matrix found low correlation between independent variables, meaning the regression model was more reliable. These results show there was not a strong relationship between functional communication and CVI, though this may be explained by the small sample size. Future research could reexamine this study with a larger sample, or determine how SES impacts neurocognition in childhood cancer survivors with CIHL.

Sophia Bondikov

The Extent to which Anthocyanins in Tart Cherry Extract Decreases Inflammation and Improve Performance in *Drosophila melanogaster*

Mentor:
Dr. Cale Whitworth
BDSC

Many athletes are taking tart cherry supplements as there is evidence suggesting they may improve performance. During prolonged periods of exercise, pro-inflammatory cytokines are produced, increasing oxidative stress and inflammation levels in the body. Anthocyanins, pigments abundant in tart cherries, may be responsible for ameliorating inflammation by blocking cytokine production. The purpose of this study is to determine if the mechanism tart cherry supplements improve performance is by decreasing inflammation, as minimal studies have been exploring this. It is hypothesized that the higher the anthocyanin concentration is, the less inflammation there will be, which will result in improved performance. To test this hypothesis, the model organism *Drosophila melanogaster* was used, which expresses Green Fluorescent Protein (GFP) in the presence of inflammation. A dose-response study was conducted by substituting 0, 5, 50, 500, and 1000 μM anthocyanin concentrations for water in the homemade cornmeal food following the BDSC recipe. Flies raised on the different concentrations underwent two hours of continuous exercise in an adapted version of Tinkerhess' (2012) power tower assay. A negative geotaxis assay was conducted before and after the power tower to determine change in performance. The NIGHTSEA fluorescence adaptation to a stereo microscope was used to view GFP expression in the flies, which was quantified by eye and then scored on a scale of zero to two. Preliminary results showed flies fed 50, and 500 μM performed better than the control in the negative geotaxis assay, and the threshold for optimal performance lying between 50 and 500μM. Amounts of GFP observed by eye did not seem initially to show a pattern amongst the concentrations. Future research will involve discovering more about cytokines and specific inflammatory pathways in drosophila.

John Colacioppo

Assessing Environmental Factors Related to the Onset of Coats' Disease

Mentors:
Dr. Deborah Marron
Dr. Mary Elizabeth Harnett
Jack McGovern Foundation

Coats Disease is a rare retinal disease that causes exudation in the retina that may result in retinal detachment and loss of vision. Currently, there is no known cause or cure for this disease however studies have looked into possible genetic factors for it. Some studies theorized that there is a connection to the NDP (Norrie Disease Protein) gene however there has not been evidence to support it. Other studies have researched similar diseases such as ROP (Retinopathy Of Prematurity) and have uncovered possible environmental causes such as number of days of intubation, postnatal low weight gain, development of sepsis, gestational age, birth weight, Respiratory Distress Syndrome, excess of oxygen and Apnea episodes. Therefore, the purpose of this study will be assessing potential environmental factors contributing to the onset of Coats' Disease. The hypothesis is that similar patterns in environmental exposures, especially in the birth environment, will be identified among Coats' patients. The methodology entails surveying Coats' disease patient's mothers identified by the J*ack McGovern Coats' Disease Foundation* and *Know The Glow* about questions regarding the mother's health and exposures before and during pregnancy, the child's exposures while in the womb and during childbirth, and the child's health and development. Future research will consist of a retrospective study to explore patterns identified by the survey.

Mark Colacioppo

Analyzing the Role of Birds on the Spread of the Invasive Japanese Barberry in a Rural Town in Upstate New York

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

Invasive species have no natural predators in an area and therefore crowd out native species and disrupt ecosystems. Specifically, the Japanese barberry doesn't require much sunlight so it can grow almost anywhere the seeds are dropped which then overshadows light-dependent plants, effectively decreasing their population. This leads to less biodiversity and upsets the food chain for native plants and animals in the area. The purpose of this study was to determine the vector by which the invasive Japanese barberry bush spreads.The methodology consists of 4 parts: 1. Mapping the spread of the Barberry bush on an ~140 acre property in Upstate New York, 2. Determining if there was a correlation between bird migration and spread of the Japanese barberry, 3. Modeling the digestive system of birds versus mammals to determine their effect on barberry germination rates, and 4.Creating a model to predict future spread of barberry based on bird populations.The preliminary results show that barberry bushes grow under canopies and electric wires, potentially because perched birds release seeds that they consumed in their feces. In addition, bird migration maps and barberry sighting maps show similar Northeast to Southwest patterns. Determining the mechanism of spread could be important to find innovative ways to prevent the Japanese barberry from dominating and disrupting additional ecosystems.

Isabel Cross

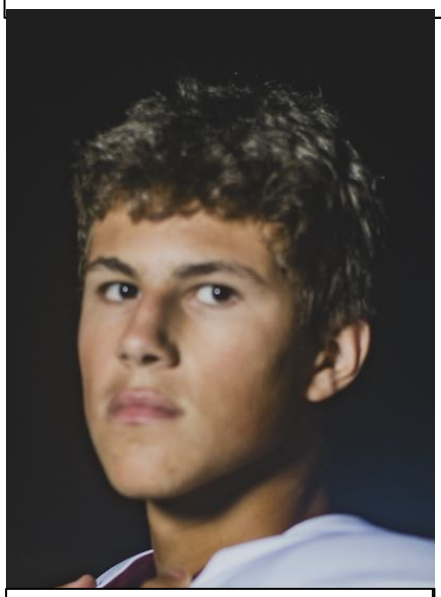
The Effect of the Gene AMPdeam on Performance in *Drosophila melanogaster:* Implications of Genetic Testing on Specialized Training and Injury Susceptibility

Mentor:
Dr. Cale Whitworth
Bloomington Drosophila Stock Center

It is unknown whether environmental or genetic factors determine athleticism. Many studies have questioned whether certain genes provide an advantage in athletic performance. AMPD1 and AMPD2 are human genes that code for enzymes in the purine nucleotide cycle that provide quick bursts of energy to the muscles during exercise. 9 known mutations may cause skeletal muscle pain or weakness after exercise or prolonged physical activity (exercise intolerance). Therefore, an unmutated AMPD1 and AMPD2 gene may provide an advantage in continuous exercise. *Drosophila melanogaster* was studied because it has a homologous ortholog for AMPD1 and AMPD2 called AMPdeam. To test the effect of the mutated AMPdeam gene, a Negative Geotaxis Assay tested short-term exercise and The Power Tower Assay tested continuous exercise. An original design of The Power Tower was constructed for this study. Results showed that even though the wild-type outperformed the AMPdeam deficient flies in both assays the percent difference between the AMPdeam deficient flies and the wild-type flies was significantly different in The Power Tower compared to the Negative Geotaxis ($p<.05$). Implications include further research may be warranted to determine whether AMPD1 and AMPD2 in humans provides an advantage to athletes in continuous exercise. In addition, knowing the role of the AMPD gene family in exercise could help tailor specialized training programs to maximize the performance potential of an athlete and minimize injury risk/improve post-injury outcomes.

Caua Dos Santos Barofaldi da Silva

An Analysis of the Impact of Cold-Water Therapy on the Reduction of Muscle Fatigue, Physical Performance, and Strength Intra-Workout



Sport professionals and health specialists are often looking for ways to improve the performance of athletes. Cold water therapy (CWT) is a form of recovery where the cold temperature from the water reduces inflammation and fatigue. Finding ways to improve performance and overall strength helps players on a sports team to achieve better results and have an advantage over others. The purpose of this study will be to determine the effectiveness of CWT in increasing performance in the weight room. It is hypothesized that CWT will aid in immediate recovery because it will reduce inflammation.. The methodology will involve testing high school athletes from a football team over a 6 week period to determine how the experimental group benefits from CWT when doing repetitions of squats in contrast with the control group. It is expected that the experimental group will experience immediate recovery and a smaller percent change over time in the number of repetitions of squats completed.. Further research will explore whether the improved performance will aid in increasing leg strength needed for improved place kicking.

Mentor:
Mr. Chris Grippo
HHS

Dean Edwards

Evaluating the Risk of Head Injury in Athletes Who Play High School Contact Sports

Chronic traumatic encephalopathy (CTE) is a degenerative brain disease that is caused by repetitive hits to the head and is typically seen in athletes. When CTE is studied, it is generally in higher profile and professional athletes, so looking at high school athletes will give a better understanding of their risk of head injury. A survey was constructed for high school student athletes who played contact sports to understand which contact sports put high school athletes most at risk for a head injury. Results showed male football and wrestlers experienced significantly more hits per game and per practice than basketball, lacrosse, soccer, and hockey ($p<.05$). There was also a strong relationship between the number of head injuries and the severity of those head injuries. Understanding that these sports have the highest incidences of head injury can lead to further steps to preventing these head injuries, and potentially preventing CTE.

Mentor:
Dr. Julian Bailes
North Shore Hospital

Taylor Hackett

Determining whether the PRKG1 Gene Mutation is a Viable Risk Factor for Memory Dysfunction in *Drosophila melanogaster*.

Mentor:
Dr. Chris Tyler
HHS

Post-Traumatic Stress Disorder, or PTSD, is a result of exposure to an individual or series of traumatic events. In the United States, 1 in every 13 adults are likely to develop PTSD, with 10% being female and 4% being male. Those affected by PTSD most typically experience symptoms such as recurring flashbacks, nightmares, avoidance, and declarative memory dysfunction. A significant majority of PTSD cases are impacted by impaired cognitive memory as well as develop fragmented and confabulated connotations with the traumatic event. Post-Traumatic Stress Disorder is oftentimes a result of neurological alterations in the hippocampus and amygdala resulting from emotional stimuli. However, there is a potentiality of risk as a result of genetic implications regarding heritability. The purpose of this study is to determine whether the PRKG1 gene mutation is a viable risk factor for memory dysfunction in *Drosophila melanogaster*. It is hypothesized that PRKG1 will impair memory ability in the *Drosophila*. Therefore, this study will determine the impact of the PRKG1 gene mutation on memory. The methodology will consist of two fly variants - one with the gene mutation and the other Wild Type, and will use a maze to determine the effectiveness of memory processes. Following the primary trials, the flies will be supplemented with the antioxidant, Vitamin E. The flies will then be tested again, based on memory ability, and data will be recorded. It is expected that the PRGK1 will inhibit the flies' memory recollection, and the Vitamin E antioxidant will rescue the behavior. This experiment may potentially spark further research regarding the genetic implications of PTSD and memory inhibition.

Sara Hanna

Determining How the Proximity of a Smartphone Affects Adolescents Sleep Procrastination Habits

Mentor:
Ms. Allison Blunt
HHS

Revenge Sleep Procrastination is a phenomenon where adolescents tend to delay their sleep in favor of leisure activities, especially when their schedule is stressful and lacking in free time. Later bedtimes can result in sleep deprivation which can have serious negative physical and emotional consequences. Taking steps to avoid stimulants such as access to a smartphone before bedtime may be necessary to ensure sufficient sleep. Therefore, the purpose of this study was to determine how the proximity of a smartphone affects adolescent sleep procrastination habits on school nights. High school aged teens were tested over a series of 9 school nights. Every 3 nights, participants were asked to move the position of their phone from arm's length, to across the room, and to another room. Participants wore a smart watch to record their time spent asleep and time in REM sleep for each night. They also kept a sleep journal recording the length and quality of their sleep each night. Preliminary results showed that when participants' phones were in another room their delay to sleep was decreased, and thus they partook in the least amount of sleep procrastination. Participants also reported that they got the best quality of sleep when their phones were at a decreased proximity, reporting their best overall quality of sleep (average 3.9/5), when their phone was the furthest away from them. Thus, recognizing that when an adolescent's smartphone is the furthest away from them, they participate in the least amount of sleep procrastination, potentially improving their health and mental-wellbeing.

Ryo Ide

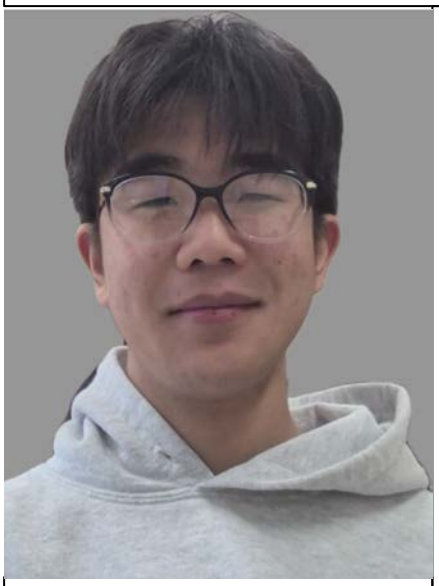
Developing Practical Early Countermeasures for Wildfires: An Explainable AI Approach

Mentor:
Dr. Amirhesam Yazdi
University of Nevada, Reno

Smoke develops in the early stages of a wildfire and is vital to early prevention, but a new detection method is needed because smoke tends to be challenging to spot. This study used an image-based approach to smoke. A promising method is to train an object detection model powered by a deep neural network (DNN) employing images from vantage point surveillance systems, including HPWREN and ALERTWildfire. State-of-the-art object detection models for this task suffer from low data diversity and quantity, making them susceptible to hidden biases; moreover, they are black boxes, making it challenging to locate and explain the bias. Therefore, this study used Explainable AI (XAI) algorithms on an object detection model's two most prominent components to systematically identify which hyperparameters should be adjusted; targeted hyperparameters would be automatically optimized using Bayesian Optimization (BO), making the model improvement process procedural rather than guesswork. Saliency maps from the first step of XAI analysis revealed that the model had correctly captured smoke, but high confidence thresholds inhibited its accuracy. In the second step, a low-dimensional embedding technique revealed that an optimal threshold exists. In the third step, the confidence threshold was optimized with a BO algorithm, which was shown to produce a ~23% increase in true positives ($p<0.05$) and a ~14% decrease in false negatives ($p<0.05$). This was the first known instance where a generalized three-step XAI analysis procedure was used to efficiently develop human-in-the-loop wildfire smoke detection models, which could help prevent wildfires and save lives.

Shun Ide

The Overlearning Test for Detecting Artificial Intelligence Failure



Mentor:
Dr. Djallel Bouneffouf
IBM Research

Despite the popularity of artificial intelligence (AI) applications, there is a lack of quantitative metrics to contest the effectiveness of AI in a given scenario. There have been situations where AI is widely inaccurate. For instance, Zuckerman (2023) found that AI had limited success in predicting stock market dynamics. A possible explanation is that the complexity of the market is so great that its dynamics are essentially random and thus unpredictable. Thus, the randomness of the market may be contributing to AI's failure in prediction. This study proposes a generic framework for quantitatively testing the risk and vulnerability of AI systems to biased decisions. The fundamental principle is that the AI system must refuse to learn any spurious patterns if the training data is governed solely by randomness. This study argues that this "overlearning test" should be integral to AI contestability. It is demonstrated empirically that AI algorithms can be trapped by spurious patterns. The game of roulette was employed as its chances to win are essentially a "dice roll" and thus random. An AI agent using Reinforcement-Learning strategies was unable to outperform an agent using the baseline method of *random guessing*. The proposed framework not only offers a simple approach to contesting AI systems but also gives substantial insight into the topic of decision-making itself. AI failing at roulette mimics a pathological, irrational gambler in real life. If AI fails via overlearning, it mirrors the blurred foresight of a human gambler.

Sophia Jonisch

Evaluating Barriers Faced by Physically Disabled Patients when Accessing Healthcare Services in a New York City Hospital Outpatient Setting

Mentor:
Ms. Allison Blunt
HHS

Health equity means the attainment of the highest level of health for all people. Relative to the general population, people with disabilities are more likely to be sedentary and to have more health problems, and are therefore more likely to spend time in a hospital setting. Given that 15% of the global population (over 1,000,000) live with a physical disability, it is important to understand their experiences. This study will investigate the barriers faced by physically disabled patients when accessing healthcare services in a New York City hospital outpatient setting and assesses their satisfaction with the care they received. A group of random outpatients from the hospital were surveyed, with a focus on questions about accessibility. The survey was distributed by the front desk employees when checking in. The expected results are to see that physically limited individuals will not be satisfied compared to their physically able peers in a healthcare setting. Because these individuals will typically not have their accommodations met and will therefore rank the hospital's treatment lower than the average patient. By understanding these challenges and satisfaction levels, policymakers can implement interventions to enhance quality of care for this marginalized group. This research can contribute insight into improving healthcare outcomes for physically disabled individuals and any patient that comes into a hospital.

Elias MacMillan

Plants May Reveal Where a Corpse is Buried: How the Stages of Decomposition of Pork Affect the Growth Rate of *Papaver somniferum*

Mentor:
Dr. Christopher Tyler
HHS

Many murder cases go cold, meaning that the case has been opened and unsolved for at least 3 years. A possible reason could be that the body was dismembered, dispersed, and buried underground. Forensic botany uses plants as evidence to reconstruct a crime. Cholewaa *et al.* (2022) found that decomposed pig limbs increased growth, number of flowers, number of leaves, and the width of the leaves of *Begonia semperflorens*. However, few known studies have looked at how bodies in different stages of decomposition affect the growth rate of plants. Therefore, the purpose of this study was to determine the relationship between pork at various decomposition stages and the growth rate of poppies (*Papaver somniferum)*. Pork was chosen because it is the closest meat to humans. It was hypothesized that the pork in the putrefaction (5 days) will increase the growth rate of poppies because the nutrients in the pork will be absorbed into the soil faster. Terrariums will be used to create an artificial environment that mimics that of a real crime scene. The pork will be decayed in 4 stages (no decay, putrefaction, butyric fermentation, and dry decay) with one terrarium housing no meat as control. Germination rate, number of leaves, and the approximate height were recorded every 5 days until 20 days when final measurements were taken. Preliminary results showed that the no meat group had a greater percent germination and were significantly taller than the no decay and 20 decay group ($p<.05$). However, there were no significant differences between the decay groups.

Martina Marcinkevicius

Mental Wellbeing as a Mediator in the Relationship Between Family Affluence and Oral Hygiene / Oral Health

Mentor:
Dr. Anouk Geraets
Université du Luxembourg

Oral health refers to the overall condition of the mouth; including the condition of oral structures of teeth, gums, tongue, and other oral tissue. Oral health contributes to whole-body health, meaning that issues with one's teeth and gums can lead to other health concerns like high blood pressure, high cholesterol, and an increased risk of heart disease, heart attacks, and strokes. Oral hygiene refers to the practices and habits one has to keep their oral cavity clean, and free of diseases by regular brushing of the teeth and adopting adequate hygiene habits. Many studies have established the relationship between lower family affluence and poorer oral hygiene and oral health. And, several studies found that adolescents were less likely to brush their teeth if they reported lower scores of mental well-being. However, it is unclear if mental well-being serves as a mediator for the relationship between family affluence and oral health and hygiene. 102 adolescents from the Northeastern US were surveyed. Participants were evaluated using the Family Affluence Scale, Warwick-Edinburgh Mental Well-Being Scale, and two self-developed measures to rank Oral Hygiene and Oral Health. Results revealed that mental well-being partially mediated the relationship between family affluence and oral hygiene and health, 76.99% of the relationship between family affluence and oral health, and 48.29% of the relationship between family affluence and oral hygiene were explained by mental well-being. Toothbrushing behavior also emerged as a significant contribution, explaining 11.8% of the relationship between family affluence and oral hygiene. These results imply that a lack of access to mental health care, for less affluent individuals, may contribute to inadequate oral care practice and subsequently poor oral health and hygiene, potentially leading to future pathologies.

Adriana Marraccini

How Wearing Sporting Equipment Affects the Diversity of the Skin Microbiome of High School Athletes

Mentor:
Ms. Allison Blunt
HHS

Many athletes suffer from Atopic Dermatitis (AD), a condition that causes itchy, dry, and inflamed skin and is characterized by the overgrowth of pathogenic microbes and reduced skin microbial diversity. The skin microbiome consists of a diverse microbiota that fends off pathogens and aids in immune defenses. It is unclear what causes changes in the skin microbiota of athletes to cause AD. It is possible AD can be exacerbated in the places where skin touches equipment, altering the microbial community. Therefore, the purpose of this study will be to determine whether there is a change in the flora of the skin microbiome in the locations where sporting equipment touches the skin. The hypothesis will be that the skin microbiome will be less diverse in areas touching sporting equipment because other materials can change the skin microbiota. The methodology will involve two parts. 1. Surveying participants to determine whether they have a history of itchy skin/AD. 2. Culturing swabs on tryptic soy agar plates of the participant's skin where equipment touches the skin both before and after lacrosse practice. Changes in colony shape, size, color (chromogenesis), texture, elevation, and opacity will be measured every day over a 5 day period to determine whether the equipment affected the microbial growth. Implications include the possibility that the sporting equipment we use for protection is actually exacerbating uncomfortable skin conditions.

Heidi Monke

Determining The Extent to Which Lutein has a Neuroprotective Effect on Alzheimer's Model *Drosophila melanogaster*: A Dose Response Study

Mentor:
Cale Whitworth
BDSC

Alzheimer's disease affects over 6.7 million Americans over the age of 65. The prognosis of Alzheimer's disease is poor with little success rate and few treatment options. An imbalance between the production of reactive oxygen species (ROS) and antioxidant mechanisms causes a form of metabolic stress referred to as oxidative stress. Free radicals which are unstable molecules damage the mitochondria causing the production of toxic amyloid beta in the synapses in the brain. Consuming antioxidants through a diet in many different forms can reduce the damage of ROS and mitigate oxidative DNA damage. Lutein is a carotenoid that portrays antioxidant and neuroprotective properties that have been associated with neuroprotective effects yet, has only been studied within observational studies. This study explored the effects of lutein on the validated Alzheimer model transgenic *Drosophila melanogaster* using a GAL4-UAS system expressing the human "Arctic" Aβ42 mutation to determine if lutein decreases AD-associated effects. A dose-response study was conducted to determine if lutein improved the neurological function in the Alzheimer model flies. It was hypothesized that as the concentration of lutein increases, the Arctic flies will experience improved locomotor and longer lifespans as measured through a negative geotaxis assay and the generation of Kaplan Meier curves. Alzheimer's disease is associated with a progressive deterioration of movement over time therefore assessing locomotor ability could indicate neurological function. Implications include that lutein is a low cost and easily accessible treatment option that could potentially decrease Alzheimer's symptoms and therefore further testing could be warranted on more complex animals.

Yaseen Osman

Creating a Computer Algorithm to Tune Frequency Bands of Electrodes on Sound Environment

Mentor:
Mr. Michael Klein
Canary Connect, Inc.

Over a billion people suffer from hearing loss and another billion are at risk. Most hearing loss is permanent and has no cure. However, Cochlear Implants are a device that was invented to treat those with severe hearing loss and even deafness. It works like an artificial ear and sends nerve signals straight to the brain. The issue is that Cochlear Implants have to do what 15,000 hair cells do with only upwards of 22 electrodes. Each hair cell has a range of frequencies that it can process, when there are thousands of hair cells that is no issue, but when there are only 22 electrodes it affects the quality of hearing for Cochlear Implant users. The purpose of this study was to create a program that fine tunes electrodes to improve sound quality. The method involved using a computer algorithm that filters out desired and undesired noise from audio, then performed a frequency analysis on the audio using a fourier transform to find the range of most prominent frequencies in the desired audio, and finally used this frequency range to find the best tuning of the electrodes in that moment in order to have a better perceptual quality of audio for the CI user. This would make the electrodes dynamically tuned which would make up for there only being 22 electrodes instead of 15,000 since they will adapt to any situation. The results showed that the algorithm successfully activated more electrodes, improving sound quality. This algorithm could be revolutionary for hearing technology. Further research is needed to adapt it to Cochlear Implants to ensure that the users are back to having close to normal hearing.

Reese Potash

Determining Whether Academic Performance is a Mediator Between Adverse Childhood Experiences (ACEs) and Juvenile Delinquency

Mentor:
Dr. Christopher Stout,
UC San Diego

Juvenile offending best describes an instance when an individual, aged 16 or younger, commits an action that would be deemed a "crime" if they were an adult, and accordingly receives legal consequences. Adverse childhood experiences, also known as ACEs, include struggles such as childhood trauma or sexual abuse. Unsurprisingly, these ACEs have been found to substantially increase the rate of juvenile offending, establishing a relationship between the variables. High school dropouts are three and a half times more likely than high school graduates to be arrested, and eight times as likely to become juvenile delinquents. Therefore, studying the relationship between academic performance, juvenile offending, and ACEs through an analysis of highschool grades, participation in extracurriculars, and dropout rates is critical to developing a deeper understanding of the way these variables interact. The purpose of this study is to determine if academic performance serves as a mediator for the relationship between adverse childhood experiences and juvenile offending, through analyzing research performed by the Inter-university Consortium for Political and Social Research site. This data comes from the Pathways to Desistance study, an open-sourced collaborative project of 1,354 serious juvenile offenders over the course of seven years. Through the use of the Statistical Package for Social Sciences (SPSS), the variables were then sorted into x ACEs, x mediating factors, and x juvenile delinquent experiences. A factor analysis was performed to standardize the variables, followed by a mediation model to see if academic performance can explain the relationship between ACEs and juvenile delinquency. This research could shed light on the overlooked importance of staying in school to deter juvenile offending.

Samantha Ramirez

The Impact of Parvalbumin and Perineuronal Nets on Parenting Behaviors in Male Mice

Mentor:
Dr. Ilaria Carta
Albert Einstein College of Medicine

Infant-directed aggression are behaviors by an adult towards an infant of their same species. Parvalbumin (PV) is a protein, and Perineuronal Nets (PNNs) are extracellular matrix structures within the hypothalamus that are responsible for influencing adult's behavior towards their children. The purpose of the study is to see how PV and PNNs impact male mice's behaviors towards pups. Preserved brains that otherwise would have been discarded were immuno-stained and observed under fluorescents to determine the presence of PV and PNNs within the hypothalamus' perifornical area (PeFA); they were found in the posterior part of the PeFA. Additionally, videos of a behavioral assay created prior to this study were rescored to determine a holistic commitment to parenting rather than individual instances of parental actions. Before the second half of the behavioral assay, half the mice were injected with ACSF or Chondroitinase (chABC). The ASCF is a placebo substance, whereas the chABC breaks down PNNs in the brain. The mice were recorded to analyze their interactions with pups before and after the injections. After the injection of chABC, a significant number of the mice became neglectful, thus revealing the influence of PNNs on parental behaviors ($p<.05$). Due to the similarity in neural circuits between mice and humans, these findings may extend to the parenting dynamic between adults and their children.

Massimo Reali

Using Drug Delivery Systems for Colon Cancer to Evaluate Effectiveness of PLGA-PEG Based Nanoparticles Loaded with Folic Acid & Oxaliplatin on Cytotoxicity of HCT-116 and HT-29 Cell Lines

Mentors:
Dr. Jennie Williams,
Dr. Justin Fang, Stony Brook
Dr. Georgios Matthaiolampakis,University of Louisiana at Monroe

Oxaliplatin is a platinum-based chemotherapy drug facilitated in colon cancer cell lines used to produce high proliferation rates of cancer cells within the tumor microenvironment. Nanocarriers are small agents that can encapsulate chemotherapy drugs to effectively deliver a drug to the designated tumor site, to improve drug delivery efficiency, effectiveness and selectivity. The purpose of this study was to determine if the use of PLGA-PEG nanoparticles decorated with folic acid quantifies the effectiveness of the platinum based drug oxaliplatin in colon cancer HT-29 and HCT-116 cell lines making drug delivery more efficient and effective to a targeted area. The methodology consisted of three different steps: 1.PLGA-PEG nanoparticles were formulated using single-emulsion methods 2. A calibration curve of oxaliplatin was constructed at different wavelengths using a phenanthroline assay to quantify the drug 3. XTT-Assay was used to measure colorimetric viability of the HCT-116 and HT-29 cell lines to determine the effectiveness of PLGA-PEG based nanoparticles loaded with oxaliplatin and folic acid. Results showed that under SEM Imaging, the nanoparticle group with oxaliplatin and folic acid was significantly smaller than the other samples ($p < 0.05$), meaning that these particles had a higher chance of reaching the tumor site and were more targeted. This showed promise as smaller nanoparticles are able to pass through more efficiently and effectively, while targeting the tumor site itself rather than spreading to key lymphatic systems and organs in the body, However, no color change was observed in the HCT-116 or HT-29 cell lines in the XTT colorimetric assay, indicating that the cells were not treated by any of the four nanoparticle groups. More research is needed to refine the encapsulation techniques of PLGA-PEG nanoparticles, improving the ability of these nanoparticles to target the tumor site.

Siobhan Rice

The Impact of Effluent on River Life Surrounding Outfalls Compared to Runoff from Tributaries

Mentor:
Ms. Rebecca Van Tassell
Cary Institute

Septic systems are decentralized, compact systems of wastewater treatment that are individualized and separate solid and liquid waste, filtering and releasing the liquid waste and storing the solids for removal. City sewers are centralized systems that serve large communities by collecting all the waste from homes and businesses in the community and transporting it to a wastewater treatment plant. The purpose of this study will be to determine the effect of effluent from local wastewater treatment outfalls on the surrounding aquatic environment and how it differs from runoff from septic systems. The hypothesis will be that septic system runoff will have the highest levels of nitrogen and phosphorus, making it an unhealthy living environment for pond protozoa. The methodology will involve collecting water samples from the Hudson River from 3 locations: sewage treatment plant outfalls, confluence from areas that use septic systems, and mid channel locations. Water quality testing will be conducted at each location to determine nitrate levels, phosphate levels, salinity, dissolved oxygen, pH and turbidity. In addition, protozoa (Amoeba, Paramecium, Euglena, Stentor, Volvox, Chilomon) from Carolina Biological's Minipond Ecosystem Kit will be raised in each sample and observed over a period of 4 weeks to indicate competition, diversity, and population changes. It is expected that confluence samples will be of the worst quality because water from wastewater treatment plant outfalls goes through several levels of filtration and cleaning, whereas septic effluent is only filtered once before passing through soil and reaching waterways.

Chloe Rooney

The Effect of Early Childhood Language Exposure in Children from Multilingual Households on Language Aptitude in Adolescents

Mentor:
Mr. Chetan Hertzig
HHS

Over 20% of children in the United States speak a language other than English at home, which is almost 66 million children being exposed to more than one language in their daily lives. However, with English being the most commonly spoken language in the United States, many children lose this ability due to a lack of use as they get older. Language aptitude refers to a person's relative potential to learn a new foreign language. The purpose of this study will be to determine if exposure to multiple languages in a person's early childhood will increase their aptitude for language in adolescence. The hypothesis will be that if a person is exposed to multiple languages throughout their childhood, they will have a greater aptitude for learning a new language in their teenage years. The methodology will involve high school students ages 14-18 being surveyed on their exposure to language from ages 0-5. Participants will be separated into groups depending on whether or not they grew up in a multilingual household, as well as whether or not they already speak multiple languages. A control group will consist of adolescents that grew up in a monolingual household and only speak one language. The participants will be scored on their aptitude for language learning through the use of the MLAT, or Modern Language Aptitude Test. It is expected that adolescents who grew up in multilingual households will have a greater aptitude for language learning than those who grew up in monolingual households. It is also expected that the participants who speak multiple languages will have the greatest relative aptitude for language. Future research will identify whether or not the specific language spoken has an impact on a person's ability to learn languages.

Teddie Stevens

Determining Significant Drivers of Algal Blooms in the Long Island Sound

Mentors:
Mr. Michael Kausch, Fordham
Dr. Matt Aiello-Lammens
Pace University

The question regarding the identification of significant drivers of algal blooms was explored in the Long Island Sound. The definition of an algal bloom is the rapid growth of algae that forms primarily on the surface of a water body. Algal blooms can be problematic when toxins are naturally released into the water, posing a threat to local marine life. Nitrogen can accumulate in water bodies as runoff from sewage wastewater and fertilizers. Phosphorus is also a component of most fertilizers, and human activities can cause these nutrients to travel towards nearby bodies of water. It is unclear whether nitrogen compounds or phosphorus based compounds are major drivers of algal blooms. Algal blooms can be identified by their pigment, chlorophyll-a. Water sampling methods can identify this pigment, as well as other conditions present in the waterbody to gain a more comprehensible understanding of the circumstances that coincide within a bloom. A data set was received from the Interstate Environmental Commission (IEC), and statistical analyses were run to analyze the impact of total dissolved nitrogen and total dissolved phosphorus, plus temperature, salinity, and ammonium on chlorophyll-a concentrations. Water quality monitoring stations located in the mid-channel were selected as the samples collected from these areas would yield more generalizable inferences to make for the study setting as a whole. For mid-channel sites, phosphorus and temperature were identified as the most significant drivers of chlorophyll-a concentrations; although the effect of phosphorus only approached significance ($p=0.0660$) while the effect of temperature was significant ($p<0.05$). It is possible that there is so much excess nitrogen in the Long Island Sound that it doesn't act as a significant driver of algal blooms. Phosphorus may be a limiting nutrient and therefore may play a larger role in the development of algal blooms. Identifying phosphorus as a significant driver of chlorophyll-a can allow specific nutrient mitigation strategies/policies to be implemented to target this growth factor.

Jordyn Summer

How an Overload of Visual Stimuli Contributes to Social Anxiety

Mentor:
Dr. Christopher Tyler
HHS

Social anxiety (SAD or social phobia) is a mental health condition where social interactions cause irrational anxiety (fear increases and it is out of control). According to the Anxiety and Depression Association of America, 31.9% of teenagers struggle with anxiety disorders and 6.8 million adults have anxiety. There are many symptoms of anxiety such as fear of being watched and eye contact avoidance. Therefore, it makes sense that seeing others could be a mechanism responsible for triggering anxiety. In addition, Israeloff (2023) describes that panic attacks associated with an SAD may be related to symptoms of visual vertigo stemming from overloading of visual stimuli which patients may not be able to process correctly. The purpose of this study is to determine whether vision is a mechanism for producing anxious behaviors in *Drosophila melanogaster*. It is hypothesized that mutant *norpA Drosophila* with loss of vision will experience less anxious behaviors than sighted flies because the blind flies can't see and therefore won't be overloaded with visual stimuli. The methodology will employ the Wall Following (WAFO) Assay to determine anxious behavior; an increase in WAFO indicates increased anxious-like behaviors. The WAFO behavior of the mutant norpA flies will be compared to the Wild Type flies (control). Additionally, the mutant *norpA* behavior will be compared to flies expressing the 5-HT2A gene since it is a validated model for anxiety in *Drosophila*. The website Ctrax will be used to track the movement of the flies. Implications include creation of glasses and other therapies to decrease visual stimuli and lessen anxiety.

Valeria Torres

Examining Patterns of Family Engagement in an Economically Diverse School District

Mentor:
Ms. Shari Heyen
HHS

Family engagement in schools is crucial for a student's ability to socialize, adapt better to different life situations, and improve their academic performance. Low-income families often deal with stressors regarding uncertainty about housing, food, and income which can take precedence over their ability to be active engagers in their child's education. Therefore, the purpose of this study was to determine whether family affluence, a measure of family wealth, influences a family's level of engagement in their child's school in an economically diverse school district. 76 parents responded to a survey translated into three languages (English, Spanish, and Japanese) that had parents rate on a Likert scale from 1-7 their understanding of their parental role in their child's schooling, the family engagement opportunities provided by the school, the parent's understanding of the benefits of engagement, the school's entry points to engagement, and the diversity and inclusivity of the school environment. The findings portrayed a significant correlation between family affluence and total family engagement ($p<.01$). The level of education of the parent was also significantly correlated with family engagement in schools ($p<.01$). Those possessing less than high school education had significantly less engagement than those who possessed a 4-year college, Master's, and Professional degree. The implications are that schools need to do a better job engaging parents to ensure the success of all their students.

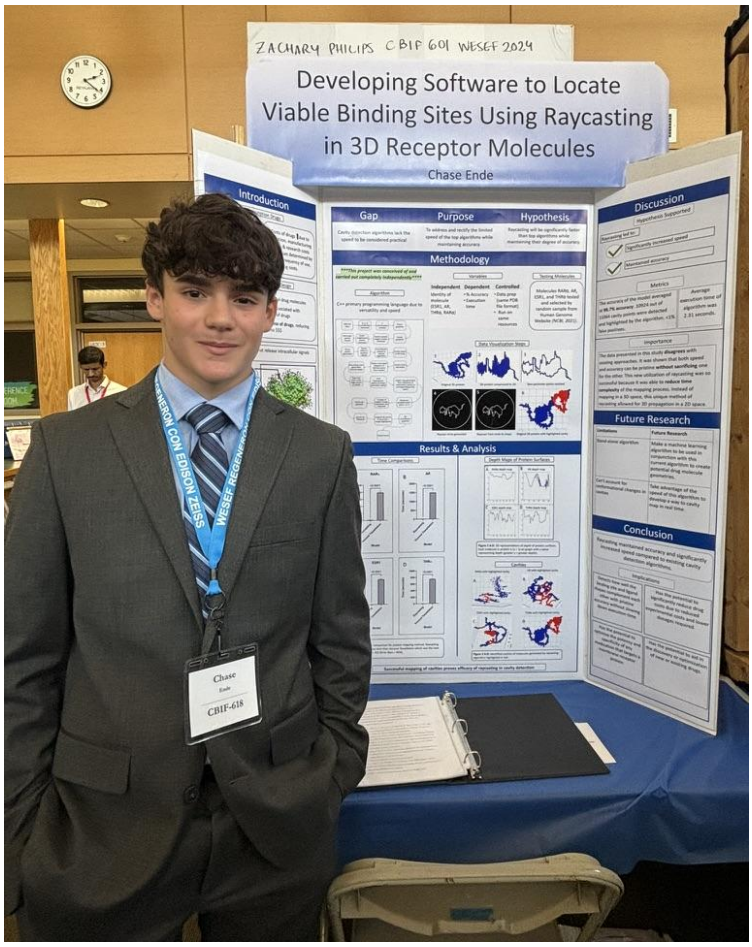
Parker Yates

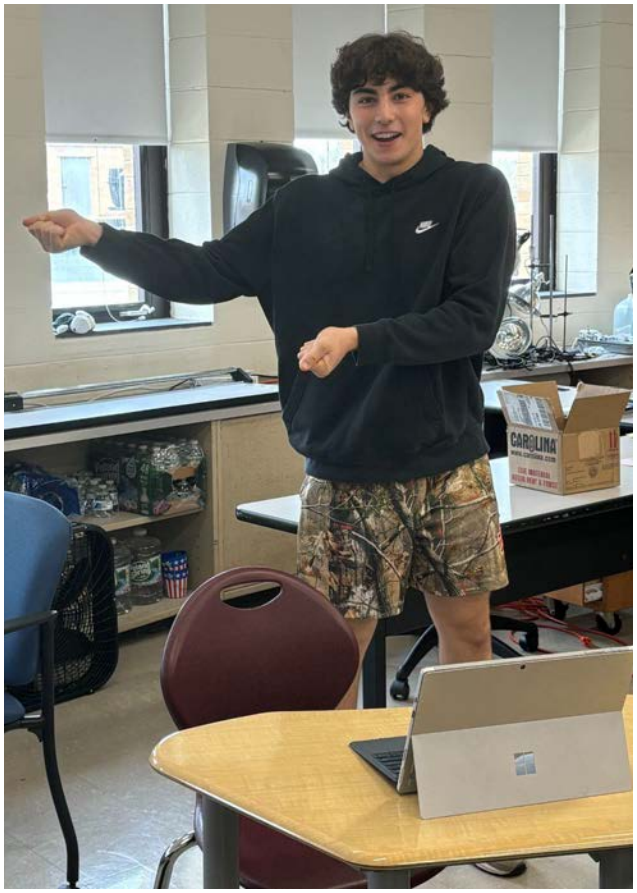
Benevolent Sexism and Investors' Startup Evaluation of Female Entrepreneurs of Different Ages

Mentor:
Ms. Nhu Nguyen
McGill University

Startups led by female entrepreneurs tend to be judged less favorably than those led by males. Employing the ambivalent sexism theory, benevolent sexism is a mechanism that may undermine gender equity in the field of entrepreneurship. Benevolent sexism varies from traditional hostile sexism and can be defined as subjectively positive attitudes towards women that perpetuate feelings of male dominance. Past research has found that benevolent sexism acts as an advantaging mechanism for men-led startups, yet it is unrelated to perceptions of female-led startups. However, how benevolent sexism behaves in the evaluation of entrepreneurs of different ages has yet to be addressed. This study explored whether the age of the female entrepreneur resulted in varying effects of benevolent sexism on investor decision-making. It was hypothesized that benevolent sexism would negatively relate to startup evaluation of older female entrepreneurs, but would have no effect on the evaluation of startups led by younger females. Results showed a slight downward trend between evaluators' benevolent sexism and their perceptions of startup viability of older female entrepreneurs compared to younger female entrepreneurs (n=60). Although not statistically significant, the effect of benevolent sexism could be magnified with further participation, meaning that benevolent sexism may negatively influence startup evaluation of older aged female entrepreneurs. This study contributes to the sexism literature by revealing the possibility of negative associations of benevolent sexism with older aged female entrepreneurs which contrasts the protective effect of benevolent sexism for male entrepreneurs.

Science Research I





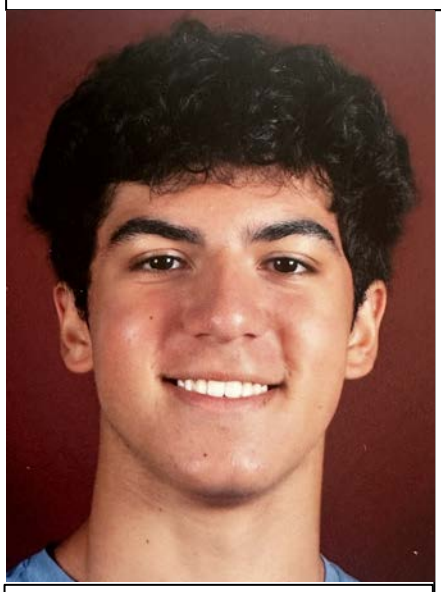
Aliyya Antilus

Correcting for Problems in Translating Jokes by AI Translators

AI translators often miss words or phrases and struggle to translate idioms, jokes, emotion, sarcasm, and irony. Humor is intimately connected to cultures and context within a specific language can be required for understanding jokes. Given that over 610 million people use AI translators such as Google Translate daily, it is important to understand the short falls of these translators and find ways to improve the algorithms to prevent misunderstandings. Therefore, the purpose of this study will be to see if using emojis and pictures will help facilitate better understanding and better translation from the source language to the target language. The hypothesis will be that emojis and pictures will provide context that will facilitate understanding in the target language. The methodology will involve translating from Haitian-Creole into English. Haitian-Creole was chosen because it is a language that occurs naturally in a human community and that is able to be translated by the Google Translator. People who speak English but not Haitian-Creole or French will be tested. Google Translate will be used to translate 10 jokes from Creole to English. Then, another translation would be given that looks exactly like the original except an emoji or picture would be added to provide context. Differences in understanding will be assessed. It is expected that the emoji's and images will help with the understanding of jokes when translated. Future research would be to design an algorithm to incorporate emojis and pictures in a translator.

Liam Azar

Using Shadow Tomography to Successfully and Efficiently Solve Nonlinear Dynamical Systems



Mentor:
Danny Qenani
Brown University

Nonlinear dynamical systems are chaotic systems where trends can be difficult to identify because of nonlinearity. Examples of nonlinear dynamical systems include the climate system and financial market; the large number of variables included with inherent noise involved in these systems lead them to be difficult to predict. Quantum computing is an innovative technology that has the potential to solve complex problems with large data sets. This is carried out with the combination of quantum mechanics and information theory to be able to theoretically revolutionize machine learning, explore complex situations in physics, and simulate different systems. Quantum computers thrive on using certain quantum properties like uncertainty, superposition, and entanglement to their advantage for carrying out different problems; however, this can come with different issues involving how the computational outputs can be measured and analyzed because of limits in quantum theory. A tool to combat this issue is shadow tomography, which extracts information from a quantum state without the need to completely recreate the state. It does this through strategic measurements and rotations. The purpose of this research is to more efficiently and effectively computationally solve nonlinear dynamical systems using shadow tomography. The hypothesis will be that using shadow tomography techniques and quantum algorithms will provide a more efficient strategy for solving nonlinear dynamical systems. The methodology will entail solving nonlinear dynamical systems using quantum computers and predicting properties of those systems using classical shadows and analyzing the efficiency and success rate of solving these systems. It is expected that the use of quantum computing will lead to a significant increase in efficiency of finding trends of dynamical systems using a quantum computer in comparison to existing methods of classical systems.

Noelie Boquet Couderc

Determining the Extent that a Hyperaccumulation of Manganese Antioxidants Provides Resistance Against Ionizing Radiation: Implications for Space Exploration

Ionizing radiation is the number one risk to astronaut health beyond low Earth orbit. This type of radiation is a form of energy consisting of subatomic particles, x-rays, and gamma rays which can remove electrons from matter exposed to it. It causes serious DNA damage, which can lead to cancer and a multitude of injuries in the body. *Deinococcus radiodurans* is an organism that was found to be highly resistant to ionizing radiation. This is due to its strong repair capabilities and hyperaccumulation of manganese antioxidants, a substance that offers protection against free radicals caused by irradiation, in its cells. However, the extent to which manganese antioxidants produce radioresistance is unclear. Therefore, the purpose of this study will be to determine if radioresistance can be partially acquired with manganese antioxidants, or if resistance relies on a combination of manganese accumulation and strong repair capabilities. It will be hypothesized that an accumulation of manganese antioxidants will increase radioresistance because manganese antioxidants scavenge reactive oxygen species created during irradiation and enhance cells' ability to mend DNA damage. The methodology will consist of two parts. First, naturally resistant organisms with strong repair capabilities, tardigrades will be fed varying amounts of manganese antioxidants and irradiated at 5kGy. Then, the tardigrades will be fed again post-irradiation and their cells' ability to proliferate will be recorded. The second part of the study will be simulating the irradiation of human DNA strands (no repair capability) exposed to manganese antioxidants and recording DNA damage. It is expected that tardigrades that are administered higher doses of manganese will have greater radioresistance and that human DNA strands exposed to manganese will have less DNA damage. Future research will investigate whether manganese antioxidants can be used as treatments against ionizing radiation on humans, specifically for astronauts.

Avery Borman

The Effect of Tryptophan on the Neurological Functioning of Parkinson Model *Drosophila melanogaster*

The gut microbiome consists of microbes that help to digest the food you eat while stimulating the immune system and breaking down potentially toxic compounds. Many different proteins are digested here, for example, tryptophan is a common amino acid which is found in foods like cheese, milk, fish, and chicken. Parkinson's disease is a brain disorder that leads to uncontrollable movements which causes struggles to the everyday life. Current thinking is that the gut microbiota can trigger inflammation leading to the progression of Parkinson's Disease. The purpose of this study will be to determine the effect of a high-tryptophan diet on neurological function and lifespan of transgenic *Drosophila melanogaster* using a system expressing human SNCA with the E46K mutation under UAS control. The hypothesis will be that high- tryptophan diets will negatively impact the neurological functions and lifespan of these *Drosophila* because it will cause the gut bacteria to release neurological toxins. The methodology will involve feeding supplements containing tryptophan to the Parkinson's model *Drosophila* and seeing how it will affect the locomotive abilities and lifespan compared to those of a wild type fly. A Negative Geotaxis assay will be used to observe the locomotive ability of the Drosophila because Parkinson's disease causes deterioration in movement over time. Kaplan Meier Curves will be used to assess changes in lifespan. It is expected that the Drosophila's neurological function will decrease the longer they are on the Tryptophan diet. More toxins will be released by the gut bacteria in the microbiome which will lead to the decline in locomotive skills and the lifespan.

Harper Canell

Evaluating the Effects of a Local Community Hospital Approach to Pancreatic Cancer Screening in an Elevated Risk Population; A Cost-Benefit Analysis

Mentor:
Dr. Joshua Raff
White Plains Hospital

Pancreatic cancer is the 4th most lethal cancer found in adults nationwide. About 66,440 people receive the diagnosis of pancreatic adenocarcinoma yearly, with only 13% surviving. The low survival rate is due to the hidden location of the pancreas. Along with the lack of symptoms, the placement increases the time until diagnosis. Due to the struggle to diagnose, scientists worldwide are creating screening procedures. A typical sequence uses Endoscopic Ultrasound (EUS) and Magnetic Resonance Imaging (MRI) in a rotation to explore the surrounding space of the pancreas for abnormalities. MRI is a non-invasive test that produces imaging of internal structures in the human body through radio waves and intense magnets. EUS is a more invasive approach, using a thin camera down the digestive tract to view any flaws. Raff et al. (2023) created a program at a local community hospital that used the rotation of these screening processes to assess people with elevated risk. The purpose of this study will be to determine the cost and benefit of implementing similar screening programs in community hospitals nationwide. A cost-benefit analysis is a statistical approach to weighing the costs and comparing them to the public benefit. It will be hypothesized that the cost and psychological benefits of the early screening programs will outweigh the price of treating cancer. The methodology will entail using a cost-benefit analysis tool developed by Roberson *et al.* (2019) to determine the Public and Financial Benefits of implementing the screening programs. Further research will determine whether specific communities have populations with more elevated risk than others and, therefore, should be prioritized for implementing pre-screening programs.

Matthew Carrea

Extracting and Repurposing Dyes from used Textiles to Create Pigments for Oil Paints

Mentor:
Dr. Julian Silverman
Fashion Institute of Technology

Global waste includes 92 tons of fabric annually. Garments such as old socks and underwear (articles that cannot be reused for sanitary reasons) and dated styles of shirts and pants often end up in landfills as a result of “fast fashion”. This trend encourages consumers to buy the latest styles, neglecting already owned garments that are still in good condition. Repurposing allows for the utilization of a product for a new purpose. This study aims to extract dyes from used textiles and repurpose them to substitute industrial toxic oil paint pigments, creating more sustainable oil paint options for artists. It will be hypothesized that dyes extracted from clothes will be successfully paired with drying oils, creating a safer alternative to highly toxic industrial oil pigments. The methodology will entail using three extractive methods (the use of laccase enzymes, acetone, and sodium hydrosulfite) to compare the success of dye removal from garments. The wastewater produced will then be separated, and the resulting dyes will undergo an atomizing and vaporizing process to transform them into powder pigments. These pigments will then be added to a drying oil (linseed oil) to form oil paints. It is expected that extracted dyes will successfully be repurposed into an oil paint that is similar in viscosity and texture to existing paints, offering a safer and more sustainable paint alternative for artists.

Chase Ende

Developing Software to Locate Viable Binding Sites by Use of Raycasting in Plane Sweeps in a Three-Dimensional Receptor Molecule

Cavity detection algorithms are the basis of computational ligand development algorithms. Accurate mapping of orthosteric or allosteric sites on receptor proteins is vital to the creation of a ligand with high affinity for said binding site. However, there are some crucial limitations regarding the ability of these existing algorithms to map out these sites accurately. The general controversy with these algorithms is the importance of balancing both accuracy and efficiency due to low efficiency being impractical for implementation with today's algorithms such as machine learning models and low accuracy being generally impractical. Leaning towards accuracy usually comes at the expense of efficiency and vice versa. Four different human receptor molecules were randomly selected from the Human Genome Website and their PDB files were downloaded. The PDB files were converted to 3D models, and then run through an original raycasting algorithm. The algorithm returned resulting surface depth maps and the input 3D model with its detected cavities highlighted. With these points, the accuracy of the model came out to be an average of 98.7% and the average execution time was 0.458 seconds. Implications include that this binding-site detection method has the potential to aid in the discovery or optimization of new or existing drugs to significantly improve people's experience on them.

Rena Etemi

The Effect of Organic Solvents in Non-Toxic Nail Polish on Nail Health

Keratin degranulation and nail brittleness is found to be common after repeated nail polish use. Although many brands claim to be non-toxic, harmful organic compounds such as benzophenone have been detected in the ingredients. Benzophenone is a carcinogenic and endocrine disrupting organic compound used to preserve cosmetic products such as nail polish. Studies have shown that this substance plays a role in the development of hormone-dependent cancers. Maintaining the health of the nails is not only important for aesthetic reasons, but also for overall well-being, as nails serve as a protective barrier for the fingertips and can reflect underlying health conditions. The purpose of this study is to Identify the effects that organic compounds, specifically benzophenone, found in nail polishes advertised as "non toxic" have on the health of nails. This study also aims to raise awareness about harmful misinformation that nail polish brands advertise about their ingredients, and eventually contribute to making changes to beauty regulations A dose response study will be conducted where keratin human fingernail models will be soaked in 0, 2, 4, 6, 8 10% solutions of benzophenone for 7 days. This fingernail model will be a film that contains keratin obtained from clean, human hair. Human hair will be delipidized in chloroform and methanol followed by the incubation with an extraction buffer to extract the keratin. Keratin degranulation and brittleness will be measured daily. It is expected that the nail polishes containing compounds such as formaldehyde and benzophenone will have the most significant effects on the nail plate, causing keratin degranulation, dehydration and brittleness.

Andrew Gaffin

Alteration of Oxygen Binding Sites on Hemoglobin to Treat Sickle Cell Disease

Sickle Cell Disease is an inherited recessive mutation of the HBB gene which codes for hemoglobin within red blood cells, the protein that allows for the transportation of oxygen throughout the body. This mutation causes hemoglobin to change from its regular tetrahedral shape to long stiff strands, misshaping red blood cells into 'sickle' shapes. These cells cannot effectively retain oxygen and often get caught in the bloodstream, causing numerous harmful side effects like anemic conditions and extreme pain. Many treatment techniques such as gene therapy to alter the HBB gene and other novel stem cell transplantation/blood transfusion techniques have been repeatedly tested with varying success, but few studies have investigated altering oxygen binding sites on hemoglobin to try and treat sickled cells. The purpose of this study will be to determine if the oxygen-binding site of mutated hemoglobin cells can be altered to optimize conditions for oxygen delivery. If a molecule can effectively change the hemoglobin cells to correct the binding site's shape, oxygen will be more successfully transferred throughout the body, decreasing the symptoms of sickle cell. The Methodology will entail using an online molecule design program called Schrödinger and the program Maestro within it to help design potential molecules. The program will then stimulate multiple real-world scenarios to test the molecules' effectiveness and report each's success. This experiment aims to find a more efficient method to target oxygen-binding sites than ex vivo gene therapy and blood transfusions which require lengthy hospital stays and total payments of over $1 million. Additionally, a drug allowing easier oxygen transfer would decrease the anemic conditions associated with sickle cell and reduce the urgency/demand for other treatment techniques like transfusions and genetic editing.

Mizuki Horiuchi

The Epigenetic Effects of Iron on the Healthspan and Lifespan of *Drosophila melanogaster* Over Multiple Generations

Iron deficiency anemia is a common condition affecting about 30% of the world. Anemia is when the body produces fewer counts of red blood cells impacting the delivery of oxygen to red blood cells, leading to fatigue and dizziness. Iron, a mineral needed for body development, helps produce hemoglobin; a protein in which red blood cells carry oxygen. Epigenetics is a change of gene expression based on environmental factors. It is possible that due to an environmental change in a parent generation could impact the offspring of the next generations. The purpose of this study will be to see whether the iron intake in the parent generation (P1) of *Drosophila melanogaster* mutant for iron deficiency (malvolio) will lead to improved healthspan and lifespan in the first and second filial (F1 and F2) generations. A dose response study where 0, 0.5, 1.0, 5.0, 10 mg/L iron (II) sulfate solutions will be used in place of water in homemade cornmeal Drosophila food using the BDSC recipe. The next two future generations will be fed the homemade food without supplementation. For all generations, performance in the negative geotaxis assay will assess locomotor ability at days 2,3,4, and 8,9,10 of life (healthspan).Kaplan Meier curves will be used to assess lifespan. Expected outcomes include that the more iron consumed by the P1 generation, the higher likelihood of an epigenetic change leading to increased healthspan and lifespan in the F1 and F2 generations.

Beverly Kang

Evaluating the Role of Plate Motion History and the Age of Oceanic Tectonics on the Deep Water Cycle

Mentor:
Allie Coonin
Brown University

Oceans on Earth emerged through the release of water vapors from Earth's interior (degassing) which condensed in the atmosphere. This process of dynamic equilibrium, deep water recycling, involves water entering the mantle through the subduction of oceanic plates (regrassing) balanced by releasing water at mid-ocean ridges. Understanding the deep mantle's role in the water cycle is crucial because it can influence the availability of water on the Earth's surface and the velocity of tectonic movement. Understanding the velocity of tectonic movement impacts our understanding of climate dynamics and the long-term stability of the ocean masses. While previous studies evaluated the effects of degassing and regassing on the deep mantle, few known studies have assessed how previous tectonic activity affected these processes. Therefore, the purpose of this study will be to evaluate the role of plate motion history and the age of oceanic tectonics on current sea levels and the deep water cycle. The methodology will utilize Matlab software to evaluate dynamic topography, and the deviation of continental topography out of isostatic equilibrium, depending on material flows that are regional and time-dependent. It is hypothesized that the simulations will reveal the interconnection between sea level and regassing and degassing.

Matthew Kirshner

Targeting Schwann Cells in Canavan Disease Using Adeno-Associated Viral Vectors

Mentor:
Dr. Paola Leone
Rowan School of Medicine

Canavan Disease (CD) is a rare leukodystrophy that affects approximately 1:100,000 births; however, the ratio is significantly smaller in Ashkenazi Jewish populations affecting approximately 1:6,400 to 1:13,500 births. Canavan Disease is characterized by a mutation of the ASPA gene causing the rapid degradation of the brain's white matter into spongy tissue. This is demonstrated through damage to axons from inadequate myelination necessary for myelin sheaths and insufficient N-acetyl-L-aspartic acid metabolization from the death of premature oligodendrocytes. As a leukodystrophy, CD primarily affects the white matter of the brain located in the central nervous system (CNS), versus areas outside of the brain and spinal cord known as the peripheral nervous system (PNS). Schwann cells are myelin-synthesizing cells located in the PNS. Like oligodendrocytes, Schwann cells can be targeted for increased myelin production through tropism from viral vectors such as an Adeno-Associated Virus (AAV) vector. The majority of research on CD is focused on increasing tropism in the CNS to boost the myelination of oligodendrocytes; however, this study proposes an alternative approach for myelination by targeting Schwann cells in the PNS. The hypothesis will be exploring the efficacy of specifically targeting Schwann cells using AAV in CD. The vector design will consist of AAV vectors using a selective promoter such as the Myelin Zero Promoter. The subject organism for this study will be nur7 CD mice. The AAV vector will be administered intraganglionically (IG) into the dorsal root ganglia (DRG) of nur7 mice. The efficacy of the treatment will be determined through green fluorescent protein (GFP) analysis in the DRG. Further research will include experimentation with varying AAV serotypes and selective promoters and their efficacy of specifically targeting Schwann cells.

Jessica Kritzman

The Relationship Between Isolation and the Effectiveness of Oxytocin on Strengthening Synaptic Plasticity in Transgenic Alzheimer's Model *Drosophila melanogaster*

Alzheimer's disease(AD) is a neurodegenerative disease that affects 1 in 9 people throughout the world, commonly affecting older adults. Alzheimer's is caused by the excessive accumulation of β-amyloid plaques in the hippocampus, which leads to weakening synaptic plasticity. Those with Alzheimer's and other forms of dementia often experience minimal contact with others, averaging two minutes of socialization a day in care homes. In the brain, oxytocin is a chemical messenger that is associated with trust and relationship building, and has recently been found to strengthen synaptic plasticity. This study will determine the relationship between isolation and the effectiveness of oxytocin on strengthening the synaptic plasticity in amyloid β42 *Drosophila melanogaster.* It has been hypothesized that oxytocin will rescue the effects of isolation in amyloid β42 *Drosophila melanogaster* because isolation decreases cognitive engagement and weakens synaptic plasticity. The methodology will entail first splitting each group of Drosophila *melanogaster (*wild, amyloid β42 expressed, amyloid β42 unexpressed) into 4 groups to be raised (isolated, isolated with oxytocin, not isolated, not isolated with oxytocin). Each group will then be tested by a negative geotaxis assay, with 10 second trials and 1 minute between each trial. The number of flies to climb past a 10 cm line will be recorded to measure the locomotive ability of the *Drosophila melanogaster in* each group. It is expected that the oxytocin will rescue the effects of isolation in β42 *Drosophila melanogaster*. Further research will investigate at what point oxytocin should be introduced in the lifespan of *Drosophila melanogaster* to maximize its effects.

Evelyn McCann

Mental Wellbeing as a Mediator in the Relationship between Emotion Dysregulation and Adverse Physical Health

Emotional Dysregulation is when an individual has difficulty regulating emotions and engages in impulsive behaviors. Many studies have found associations between emotional dysregulation and negative health conditions such as high blood pressure, body mass index and obesity, and cardiac arrhythmias. Symptoms of emotional dysregulation include extreme sadness, shame, and anxiety; therefore an established relationship exists between emotional dysregulation and mental well-being. Poor mental well-being is also implicated in negative health outcomes. The purpose of this study will be to determine whether the relationship between emotional dysregulation and adverse physical health is mediated by an individual's mental wellbeing. The methodology will involve surveying adolescent participants using the following measures: the Emotional Dysregulation Scale (DERs), the Warwick-Edinburgh Mental Well-Being Scale, and a Patient Health Questionnaire. If mental wellbeing is shown to be a mediator between the relationship of emotional dysregulation and adverse physical health, it could mean that mental health services could help improve the physical health of people with emotional dysregulation.

Simon Modica

The Relationship between Mindset and Sports Performance in High School Athletes with ADHD On and Off Stimulant Medication

Mentor:
Dr. Kareem Ghalib
Columbia University

Attention-deficit/hyperactivity disorder (ADHD) is marked by an ongoing pattern of inattention and hyperactivity-impulsivity. Increased impulsivity associated with ADHD may put athletes at a higher risk for injury. ADHD affects approximately 1 in 10 children in the US. Almost three quarters of diagnosed children are medicated, and around 80% of those who are medicated are on stimulant medications like Adderall, Concerta and Ritalin. Recently, the World Anti Doping Agency has banned the use of stimulant medications in all athletic competitions. However, it is unclear if these stimulant medications improve athletic performance or help youth athletes stay focused and avoid injury. Athletic mindset is a form of mental readiness that allows athletes to focus, train hard, and to perform at their best. The purpose of this study will be to determine whether sports performance in people with ADHD is impacted by mindset; and, if so, whether treatment for ADHD impacts mindset. The methodology will involve having high school athlete participants complete an adapted version for athletic performance of the Carol Dweck's Growth Mindset Scale while on medication and while off medication after completing athletic performance tasks. A control group of athletes without ADHD will also be tested. The intended results will be that while on medication athletes with ADHD will have similar mindsets and performance results to those who are not diagnosed.

Adeena Naeem

Quantifying the Economic Cost of Hydropolitical Conflicts on Economic Indicators in the Nile River Basin

The 2023 UN World Water Development Report found that 2 billion people lack access to drinking water. Conflicts over water have been recurring over the last century in regions of North Africa, West Asia and South Asia. Empirical data is necessary for diplomatic negotiations among increased water scarcity due to population growth and climate change. Conflicts are defined as situations in which agents choose inputs that are costly to themselves in pursuit of private gains framed as wins or losses. Water diversion is the act of taking water by gravitational pull or pressure means from a defined and naturally occurring water body into a canal or pipe line; diversion triggers conflicts between upstream and downstream actors. The purpose of the study will be to quantify the cost of hydrological conflicts focusing on water diversion. Three economic indicators will be used as dependent variables : GDP (Gross Domestic Product), agricultural productivity and hydrological infrastructure damage. It is hypothesized that water conflict reduces GDP and agricultural productivity while exacerbating damage to infrastructure. An input - output model will be constructed with data from the Water Conflict Chronology from the Pacific institute to pinpoint instances of conflict to contextualize data sets. Testing will involve scenarios with varying water diversion levels in Sudan, Ethiopia, and Egypt (0%, 20%, 50%, and 75%), with a control scenario reflecting current diversion rates. Implications include that the model can be used to create hydrological diplomatic solutions and a means for negotiation between parties. Unfair water allocation can be reduced politically as both parties are able to negotiate on terms of empirical and numerical data. There is less room for political coercion and non-political, empirical solutions can be reached preventing war and promoting rational policy making.

Mihikaa Phukan

The Effect of Different Concentrations of Cannabidiol and ∆9-tetrahydrocannabinol on the Activation of SIV-infected Microglial Cells from Simian Primate Cell Lines

Mentor:
Dr. Chioma M. Okeoma
NY Medical College

Simian Immunodeficiency Virus (SIV), a virus closely related to Human Immunodeficiency Virus (HIV) in humans, infects the microglial cells in the brains of primates; when activated the infected cells change their gene expression which changes the proteins being created by the cell. Cannabidiol (CBD) and ∆9-tetrahydrocannabinol (∆9-THC) have been shown to decrease inflammasomes such as NLPR-3, caspase-1 and IL-1B. Inflammasomes form as multiprotein complexes when an infection or stimuli is detected. The activation of NLPR-3 leads to the production of caspase-1, a pathway that promotes the production of IL-1B; when these inflammasomes are activated it means the SIV-infected cell is activated. The purpose of this study will be to investigate the effects of different concentrations of CBD and ∆9-THC on the activation of SIV in the microglial cells from primate cell lines. The concentrations of CBD tested will be .01μM,.1μM, 1μM, 10 μM and 20μM of CBD. A 2:1 ratio of CBD to ∆9-THC will be maintained to lessen psychoactive effects of ∆9-THC. It will be hypothesized that as concentration of CBD increases, the number of SIV infected-microglial cells activated will decrease. The methodology entails gathering primate cell lines that have been infected with SIV, then dividing the cell lines into 5 different groups each containing a different concentration of CBD to THC-9 (2:1). These groups will then be stained using protein indicators for NLRP-3, caspase 1 and 1 L-1β and will be quantified using IMARIS technology. An MTT Assay will be conducted to determine if any significant cytotoxicity is induced in the cells treated with the higher concentrations of the CBD/∆9-THC ratio. Future research would be to determine if CBD and THC have similar effects in human cell-lines infected with HIV.

Noah Podolak

Using Reaper Protein to Determine the Effects of p21 Deletion on the Regenerative Ability of the Wing Imaginal Disc in *Drosophila melanogaster*

Mentor:
Dr. Rachel Smith-Bolton
University of Illinois at Urbana-Champaign

In this study, the effects of p21 deletion on the regenerative ability of the wing imaginal disc in *Drosophila melanogaster* will be investigated. p21 is a tumor-suppressing gene, however, the gene has a secondary function in its deletion. The deletion of p21 has been found to promote amplified capability of regeneration. Regeneration is defined as replacing lost tissue with identical new tissue. Regenerative ability will be measured by determining the replacement of cells that have experienced apoptosis in an induced injury. The injury will be induced using the Reaper Protein which is a protein that encourages apoptosis (cell death). The purpose of this study will be to determine if the effects of p21 deletion are beneficial or detrimental. This will be measured by the ability of the wing disc of the fly to regenerate. It is believed that the p21 gene will influence regeneration inside of the body and can revert or halt artificially induced injuries. An Ablation System consisting of Rotund Gal-4, UAS-Reaper, Gal80ts, and TM6B, will be used to model the benefits of p21 deletion. Rotund Gal-4 focuses on the targeted area, while UAS-Reaper is a pro-apoptotic protein that induces damage in this system. Gal80ts ensures temperature-dependent activation of UAS-Reaper, with Reaper being dormant at 18°C and activated at 30°C. The model will measure regeneration by observing the healing of the wing disks. Lifespan and healthspan will also be measured. This experiment aims to reduce the impact that chronic wounds have on the lives of millions of Americans, as it could increase the likelihood of healing.

Mariann Ramos Abreu

Determining the Effectiveness of Turmeric in Reducing the Inflammatory Response in Genetically Altered *Drosophila melanogaster* with Green Fluorescent Protein (GFP)

Rising temperatures and levels of humidity have been creating favorable conditions for mosquitoes to breed in new regions and expand their numbers. In 2024, a growing number of deaths have been attributed to Dengue, a mosquito borne disease that is categorized by an acute inflammatory response. Since inflammatory diseases like Dengue are becoming more widespread, it is important to find low cost preventative measures to lessen symptoms and build the immune response. Studies have shown that Dengue patients showcase high levels of cytokine production. Cytokines are proteins which regulate inflammation. When germs or harmful substances enter your system cytokines signal immune cells to mount a defense; however, when a body is under stress they can be overproduced causing unwanted inflammation. *Drosophila melanogaster* can be a good model for studying immune responses because the immune signaling pathways that respond to cytokines are evolutionarily conserved from flies to humans. Turmeric is a rich anti-inflammatory compound that potentially helps reduce the levels of cytokine production and therefore may decrease an inflammatory response. The purpose of this study will be to determine whether turmeric will decrease inflammation in *Drosophila melanogaster* with a Green Fluorescent Protein (GFP) mutation. GFP will glow green when inflammation is present. A dose response study will be conducted to determine if increasing concentrations of turmeric will decrease inflammation as measured by the amount of GFP expressed. Further research will consist of using immunohistochemistry to observe cytokine expression to determine the exact mechanism by which turmeric decreases inflammation.

Emily Salemo

The Effect of Alpha-Tocopherol on Locomotor Ability of Transgenic *Drosophila melanogaster* for Glutathione S-Transferase Theta 1 (GSTT1)

Juvenile Arthritis (JA) is a form of childhood arthritis which affects approximately 100,000 persons under the age of 16 in the U.S. Low locomotor abilities decrease the quality of life for these patients by making day to day activities difficult to complete due in part to abnormalities in the tissues. There are few non-prescription options to treat the worst symptoms of this condition leaving a need for more accessible treatment options. Alpha-tocopherol (vitamin E) is an easily accessible antioxidant which has been shown to promote tissue growth and repair. The purpose of this study is to determine the effect of alpha-tocopherol on locomotor ability on a transgenic *Drosophila melanogaster* model for Glutathione S-Transferase Theta 1 (GSTT1). This model has been selected due to the role of GSTT1 in tissue erosion. A GAL4 will be used to express the human GSTT1 gene in muscle. It has been hypothesized that flies treated with alpha-tocopherol will have increased locomotor ability using a negative geotaxis assay. The methodology will involve using a negative geotaxis assay to assess the locomotion of flies treated with different concentrations of vitamin E in the form of alpha-tocopherol. Male and female flies will be tested separately because arthritis has different effects on males and females possibly due to differences in hormones. It is expected that the flies treated with the alpha-tocopherol will have increased locomotor ability. Future research will use different GAL4 flies to express the GSTT1 gene in neurons, the digestive system, and lipids to determine whether the type of tissue affects locomotor ability.

Cassidy Satterfield

How Non-Inclusive Language Affects Cisgender People's Implicit Biases surrounding Transgender People

Mentor:
Emily Sandall
Boston University

Transgender people make up only 0.6% of the population, but are four times more likely to be victims of violent crime, and almost equally as likely to be harassed based on identity. Transgender identities refer to anyone identifying with a gender identity which is differing from their assigned gender at birth. Prejudice is commonly faced among transgender people and comes from a variety of sources, from traditional gender roles (man = worker, woman = carer, etc.), to language. Language and how we refer to people around us, has an effect on individual biases. The purpose of this study will be to determine how non-inclusive language affects cisgendered people's implicit biases surrounding transgendered individuals. Implicit biases are subconcious negative attitudes which tend to inhibit a persons' ability to interact with a topic, fairly. The methodology will involve surveying a cisgendered population using multiple versions of the same survey. Each survey will be made using language with the goal of furthering differing agendas about transgender people and their identities, if only subtly. Preceding the surveys, the subjects will be asked to answer explicit questions about their perceptions of Trans' identities. It is expected that the results of this study will point to a positive correlation between language used and people's implicit biases. Implications of this study include raising awareness about the use of inclusive language when developing policies and about the far-reaching effects of language on minority groups.

Gabrielle Schiele

Using Stimuli and Positive Reinforcement to Measure Learning, Behavioral Reactions, and Cognition in *Oryctolagus cuniculus*

Mentor:
Dr. Clare Ellis
Harper & Keele
Veterinary School

Oryctolagus Cuniculus, the common rabbit, has been used in studies on Animal-assisted Intervention Therapy (AAIT) Young adolescents who struggle with cognitive disorders and who worked with rabbits have been found to show a significant decrease in levels of social anxiety and depression, as well as improvements in social skills and recognition. While the abilities of animals have proved useful in the fields of medicine and psychiatry, the extent of an animal's cognition is a complex subject of study. Cognition can be defined as the ability to acquire knowledge and understanding through experience and thought. An understanding of an animal's cognitive function and behavior must be developed in order to determine whether an animal could pass therapy training. The purpose of this study is to determine the limits of cognition in rabbits for data that could be applied to AAI therapy research and progression, and further the usage of rabbits in therapy settings. The methodology will involve the usage of stimuli and positive reinforcement to influence the performance of specific tasks and the analysis of behavioral responses to social interaction. IRB approval will be obtained and all experiments will be ethical and strictly observational, no animals will be harmed during these tests. It is hypothesized that the rabbits will display a relatively high level of emotional intelligence and receptiveness to training that would be beneficial in AAI therapy settings. However, the rabbits may struggle or display negative responses in behavior depending on the intensity of the task or situation, which must be effectively trained out of them.

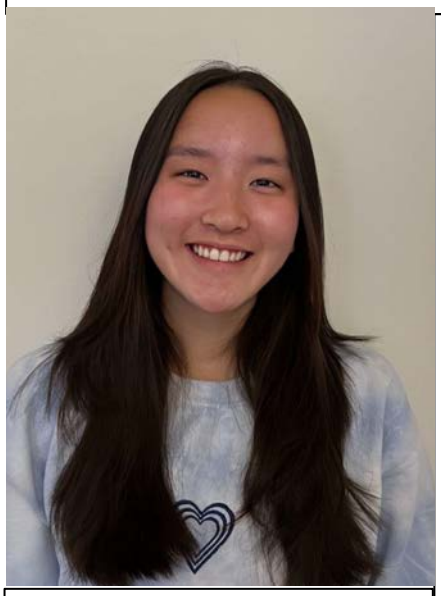
Nolan Simmons

Using Vibroacoustic Sound Waves and Vertical Visual Attraction to Lure Spotted Lantern Flies (*Lycorma delicatula*)

Spotted Lanternflies are an invasive species that are problematic in the way that they multiply during the summer months in the Northeastern United States. Spotted Lanternflies have invaded 17 confirmed states, and are expected to increase in population with each approaching season. While they are completely harmless to humans, the damage they do to over 130 different plant species is irreversible. In New York alone, the annual yield to crops is approximately $350,000,000, and scientists estimate that Spotted Lanternflies have contributed to a .09% decrease in revenue. Additionally, Spotted Lanternflies feed off sap from many tree species. This makes the tree weak and vulnerable to disease and attacks from other insects. While feeding, Spotted Lanternflies secrete a sticky substance called “Honey Dew”. This substance attracts other insect species, and promotes growth of sooty mold on the bark of the tree. Scientists have found that Spotted Lanternflies are attracted through a 60 hZ vibroacoustic stimulus . Since Spotted Lanternflies do not fly but rather hop, they rely on climbing up to higher altitude on vertical objects, and gliding downward to travel. The purpose of this study will be to determine if a combination of vibroacoustic stimuli and visual vertical attraction will be successful in luring in the Spotted Lanternflies. The methodology will involve building a frequency generator, and attaching that to a pole at least 10 feet in height. The frequency generator would produce sound signals (60 - 100 hZ) in a 360° circumference. Additionally, a camera will be set up for a time lapse that covers a 10 foot radius, which would allow for a view to count the Spotted Lanternflies. Further research will allow for exploration on more efficient ways to eradicate Spotted Lanternflies, and future establishment of traps.

Riko Suzuki

Extraction of the Pigment Titanium Dioxide in Cosmetic Waste for the Creation of Water-Based Paints



Mentor:
Dr. Julian Silverman
Fashion Institute of Technology

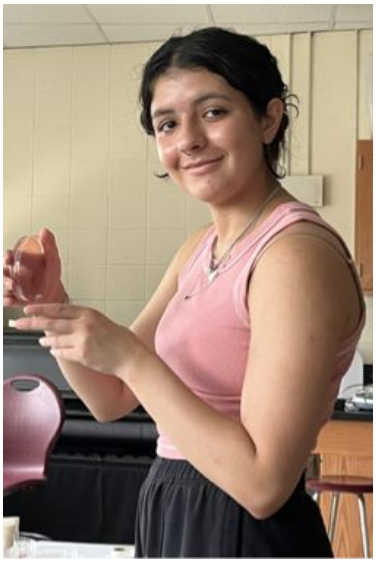
Between 20-40% of all cosmetic products go unused and end up as waste. One solution to this issue is repurposing materials in cosmetics to be used for other means. Repurposing is the idea of taking an object with one use value and transforming it into an alternative use value. Titanium dioxide is a white solid often used as pigment in various makeup products such as lipsticks. It is also used as a pigment in water-based paints, which are widely used for painting swimming pools and roofs. Therefore, the purpose of this study will be to extract titanium dioxide from lipsticks to be repurposed for the production of water-based paints. The hypothesis will be that titanium dioxide can be successfully extracted from lipsticks and be repurposed for a water-based paint. Properties such as durability and viscosity of the paint will be tested, and spectroscopy will be used to assess how its molecular structure and bonding compares to already existing water-based paints. The methodology will involve mixing the lipstick composition with hydrochloric acid and heating it in a flask. After cooling, the mixture will undergo ultrafiltration and the resulting component will be dried overnight. The synthesis of paint will be done through the mixing of four main materials; solvent (water), binder (vinyl acrylic), pigment (TiO2), and additives (pH modifier and antifoaming). It is expected that these methods will allow the formulation of water-based paints. This new idea will give unused cosmetic components such as titanium dioxide to gain a new purpose in an entirely different product, preventing more waste from being created.

Jeremy Xhayet

Using Lipid-Mediated Free Diffusion as an Alternative Drug Delivery Method for 3-Bromopyruvate

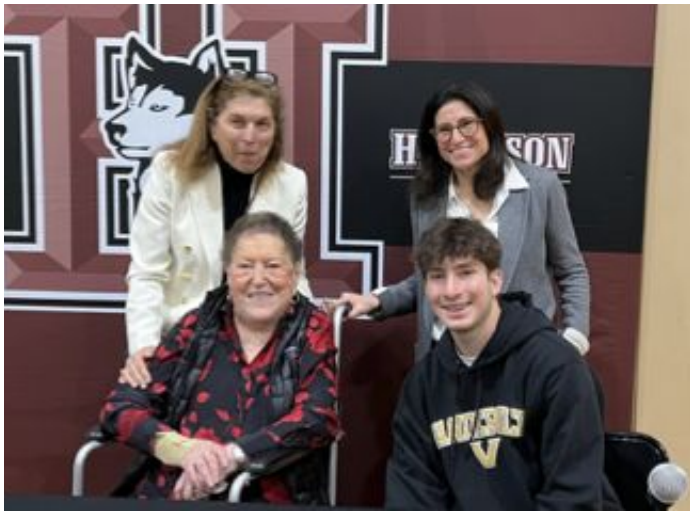
Glioblastomas are the most common form of a malignant brain cancer that affects nearly 300,000. The average survival time for brain cancer patients is between 15-18 months, with a staggering 7% survival rate for patients above 5 years. 3-Bromopyruvate is a promising chemotherapeutic drug, which travels through the monocarboxylate channels, overexpressed in cancer cells, to inhibit Hexokinase II and Glyceraldehyde 3 Phosphate, both contributing to the glycolytic processes. 3-Bromopyruvate also causes Chronic Cellular Stress on the Endoplasmic Reticulum, leading to translation inhibition. Though many positives lie in this drug, a limitation is 3-Bromopyruvate's ability to treat Glioblastomas due to it being unable to pass through the Blood Brain Barrier, due to its large size. Therefore, the purpose of this study will be to use lipid-mediated free diffusion as an alternative drug delivery method for 3-Bromopyruvate. The methodology will involve reengineering lipids to facilitate the diffusion of 3-bromopyruvate into brain endothelial cells. Brain endothelial cells will be chosen because they have tight junctions limiting passive diffusion to best approximate the blood brain barrier. An MTT assay will be conducted to determine cell viability.It is expected that lipid-mediated free diffusion will facilitate the passage of 3-bromopyruvate into the brain endothelial cells and result in an increase in effectiveness of the drug in killing cancer cells.

Congratulations to all our students!
It's been an unforgettable year!




Duke-UNC ADRC


Mets

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Special Thanks:

The students and faculty of the Harrison Science Research and Technology programs 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 the events of tonight, please feel free to contact:
Ms. Allison Blunt at: blunta@harrisoncsd.org