



**HARRISON SCIENCE
RESEARCH PRESENTS:**



The 20th Annual

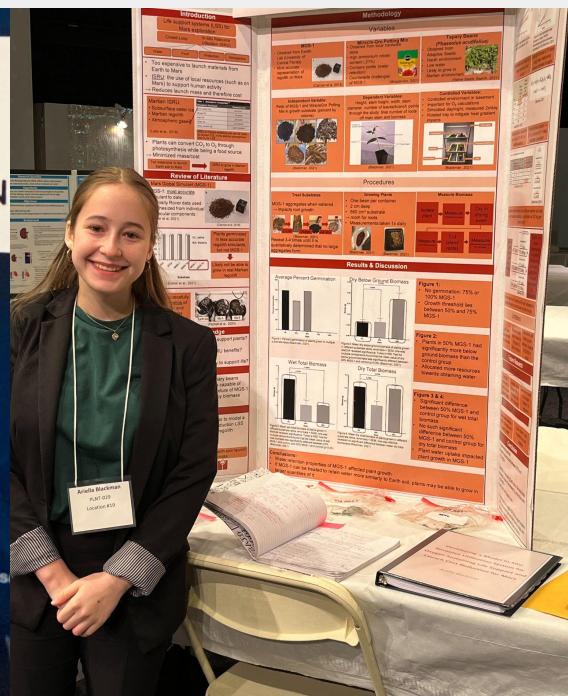
HARRISON HIGH SCHOOL SCIENCE AND TECHNOLOGY SYMPOSIUM

Monday, June 6, 2022

7:00 PM - 9:00 PM

HHS Student Union

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



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 to prepare for future science fairs.

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

- Montage - The Year in Photos
- Opening remarks by Dr. Joan O’Keeffe, Director of Science & Technology Education
- Highlights of the HHS Program by Allison Blunt & Donald Roane
- Guest Presenter & Mentor: Dr. Julian Silverman
- Project Presentation: Ariella Blackman
- 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

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.

Acknowledgements

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

Board of Education

Kelly Mulvoy Mangan, *President*
Kelly Kozak, *Vice-President*
Dennis DiLorenzo, *Trustee*
Noreen Lucey, *Trustee*

Placido Dino Puccio, *Trustee*
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Lawrence Mastrotta, *Assistant Principal*

Science Research Teachers

Allison Blunt
Donald Roane

Internal Review Board Members

Dr. Christopher Tyler, Ph.D.
Dr. Melville Francis Psy.D.
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.

Science Research III



Mai Blaustein

Identification of Chemical Contaminants in Spiked Beverages with the use of Infrared Spectroscopy through Developing Accessible Device to Identify Date-Rape Drugs

**Location of Research:**

Manhattan College

Mentor:

Dr. Julian Silverman

Will be Attending:

Yale University

Intended Major:

Chemistry

Fairs & Awards:

2022 Regeneron ISEF Finalist

WESEF 2022 - Top of the Fair, 1st in Chemistry

ASM Materials Education Foundation Award.

2022 JSHS 1st place, qualified Upstate JSHS

Regeneron STS 2022 - Top 300 Scholar

HHS Symposium 2022, 2021

Gamma Hydroxybutyrate (GHB) and its precursor Gamma Butyrolactone (GBL) are easily accessible, Class C drugs, commonly used in drug-facilitated sexual assault cases. Existing technologies for detecting date-rape drugs in drinks have significant limitations: chemical tests only look at GHB or GBL, not both, pH indicators allow for false readings depending on acidity of the drink, and visible color-based detection methods allow for drink color interference. Infrared (IR) Spectroscopy is a light-based detection method used to identify molecules from larger mixtures. The purpose of this study was to determine if IR Spectroscopy could be used to detect harmful concentrations of illegal substances such as GHB/GBL in alcoholic beverages, and to construct a proof of concept detection instrument. A placeholder chemical, caprolactone was used as it shares a similar IR profile to GBL (the precursor to GHB) since GHB/GBL are illegal substances and could not be obtained. The methodology consisted of three parts: 1. Identifying relevant peaks in the IR window using a commercial IR spectrometer 2. Using identified peaks to determine filter and detector wavelengths necessary for a proof of concept instrument 3. Testing the instrument and constructing a calibration curve to determine ranges of concentrations of contaminants that could be detected. The calibration curve confirmed the proof of concept instrument could distinguish various concentrations of caprolactone in model spiked beverages ($r^2=0.89$). Future research is needed to make the device portable and inconspicuous

Identification of Chemical Contaminants in Spiked Beverages with the use of Infrared Spectroscopy through Development of Inexpensive and Inconspicuous Device to Identify Date-Rape Drugs

INTRODUCTION

Drug-Facilitated Sexual Assault - use of drugs / alcohol to compromise ability to consent

Gamma Hydroxybutyrate (GHB)

Gamma Butyrolactone (GBL)

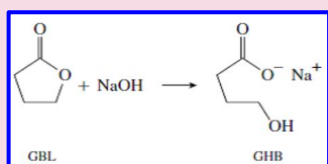


Fig. 1: Chemical conversion of GBL to GHB (taken from Weeks, 1998)

Infrared Spectroscopy: Detection of absorption of infrared light

Purpose

To use infrared spectroscopy to detect illegal substances as components of beverages and construct a proof of concept instrument

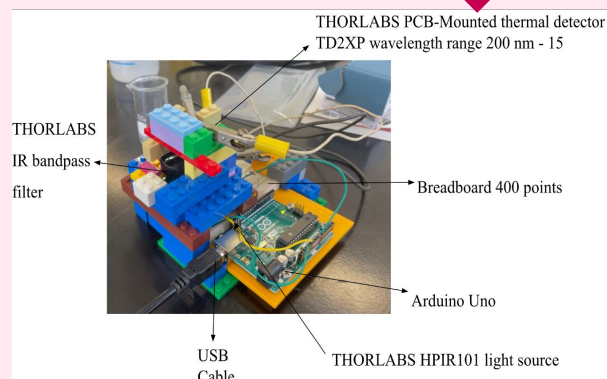
METHODOLOGY

Mixtures

Record IR spectra of 15 sample mixtures

Construct Instrument

Build proof of concept instrument



Solutions Tested: 5% 15% 40% Ethanol, Vodka, Wine, Beer, 0, 1, 5, 10, 20% Caprolactone

MAJOR RESULTS

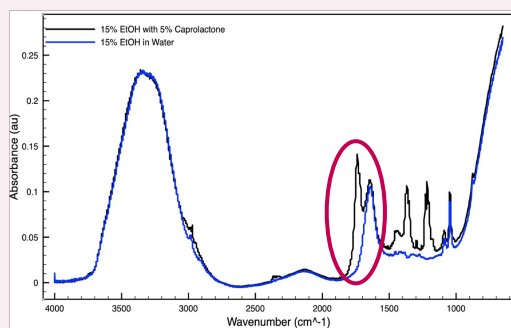


Fig. 2: Spectra graph of Ethanol with caprolactone vs. just Ethanol

Caprolactone peak identified in all Sample Mixtures at $\sim 1750 \text{ cm}^{-1}$

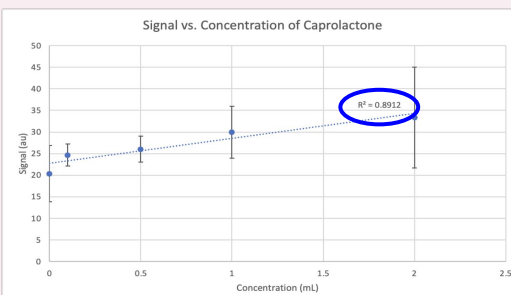


Fig 3: Signal as a Function of Concentration of Caprolactone using proof of concept instrument

High R^2 value = reliable data with low variability

Instrument works

CONCLUSION

Hypothesis = Supported

IR spectroscopy detected caprolactone without limitations of color and pH (1750 cm^{-1})

Proof of concept instrument was able to distinguish caprolactone from other components

IR spectroscopy can be used to develop inexpensive inconspicuous device

Implications

Developing a software or device to detect date-rape drugs

IR spectroscopy can detect other contaminants as well

Annie Chen

Evaluation of Neutron Star Heating Mechanisms: The Limits of Cooling Theory

**Location of Research:**

Harrison High School

Mentor:

Dr. Oleg Kargaltsev

Will be Attending:

Barnard College of Columbia University

Intended Major:

Business/Economics

Fairs & Awards:

Regeneron Science Talent Search 2022

HHS Symposium 2022, 2021, 2020

Challenges associated with observations of emission from 10-mile-sized neutron stars, extremely dense celestial objects formed through the core collapse in a massive star, result in a knowledge deficit. Two plausible explanations for why neutron stars remain hot for long time are [1] neutron stars are cooling slowly and can be additionally heated through complex internal heating mechanisms (e.g., related to internal magnetic fields) and [2] neutron stars are externally heated by energetic particles that precipitate from the neutron star magnetospheres. The purpose of this study was to examine whether external or internal heating better explains differences in characteristics of neutron stars, such as temperature and radii, looking overall at how heating relates to the age of the star. Although both internal and external heating likely influence all subsets of neutron stars, older neutron stars are expected to be predominantly externally heated (if such heating is important at all), whereas for younger stars the internal heat content is expected to be dominant. Blackbody radii of neutron stars were calculated using Stefan Boltzmann equation, then graphed versus known characteristics of each respective star (P ; spin periods, dP/dt ; spin period change; B_{dip} ; magnetic field, t_c ; characteristic age, L_{33} , and t_{inf}). If external heating is important it would be expected to see correlations between blackbody radii, t_{inf} , or L_{33} with parameters describing NS magnetosphere (e.g., P , dP/dt , B_{dip}). There were indicators for external heating correlations in small hot spot neutron stars.

The Limits of Cooling Theory: An Evaluation of Neutron Star Heating Mechanisms

Introduction

- Neutron Star: the remnants of stars' collapsed cores during supernovas

Neutron star vs. Chicago



Mass=1.4 M_{\odot} , Radius=10 km
Spin rate up to 38,000 rpm
Density= 10^{14} g/cm³, Magnetic field= 10^{12} Gauss

- Small cluster of neutron star matter the size of a sugar cube = mass of all of humanity
- Significance: provides astrophysicists with unique information about how matter behaves at extreme densities

Introduction to neutron stars. University of Maryland,
www.astro.umd.edu/~miller/

- Neutron Star Cooling Theory: concludes that as a star ages, it's internal temperature lowers
- Theorists suggest other mechanisms that modify neutron star cooling may exist [Gonzalez & Reisenegger 2010]
 - Internal Heating: Neutron Star is slowly cooling and heated through internal heating mechanisms
 - External heating: Neutron Star is heated by energetic particles precipitating from the neutron star magnetospheres

Methodology

Part 1: X-Ray Data

- Effective blackbody radius (R) was calculated using Stefan-Boltzmann Law: $L = 4\pi R^2 \sigma T$
- Tinf (eV) were taken from the extensive database. These values were put into Stefan-Boltzmann's equation.

$$R_{mid} = \frac{10^5 \sqrt{10^{33} L_{mid,33}}}{\sqrt{4\pi (5.67 \times 10^{-5}) (T_{\infty, mid} \times 11605)^4}}$$

Part 2: Ultraviolet Data

- Ultraviolet values were taken whenever possible, Tinf values were taken from publications that record neutron star observables via ultraviolet telescopes and used instead of Tinf values from X-ray observations.

$$mid L33 = \frac{4\pi(5.67 \times 10^{-5})(1.3 \times 10^6)^2 (mid Tinf)^4}{10^{33}}$$

Results & Analysis

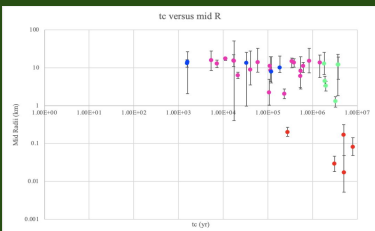


Figure 1. Characteristic age (tc in years) versus mid radius (mid R in km). Ordinary pulsars illustrated in pink; High-B pulsars illustrated in blue; the Magnificent 7 illustrated in blue; Small hot spots illustrated in red

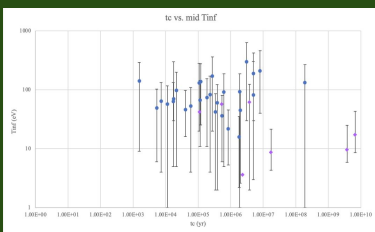


Figure 2. Characteristic age (tc in years) versus mid Tinf (eV). X-ray information illustrated in blue; UV information illustrated in purple

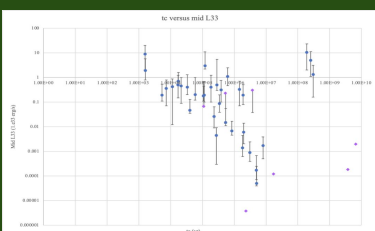


Figure 3. Characteristic age (tc in years) versus mid L33 (1.e33 erg/s). X-ray information illustrated in blue; UV information illustrated in purple

Conclusion & Future Research

Conclusion

- Hypothesis supported in some instances External heating, expected to be dominant in older neutron stars, was seen in analyzing the relationship between neutron star age and radius size.
- Small hot spots had the smallest radius size but the largest age. This offers an alternative explanation that neutron star cooling theory is currently able to generate.
- Additionally, analyzing the relation between X-ray data and UV data illustrate findings that confirm heating mechanisms.

Future Research

- If more information regarding neutron stars in the UV is published, the next step is to analyze the relationship between them and the wealth of information illustrating them in X-ray.
- Observing trends in neutron star heating mechanisms gives researchers more insight into how they behave.

Eileen Dockery

Impact of Speed Limits and Road Sinuosity on Wildlife-Vehicle Collisions Surrounding a Preserve in The Suburban Northeastern United States

**Location of Research:**

Mianus River Gorge

Mentor:

Chris Nagy

Will be Attending:

Bates College

Intended Major:

Environmental Studies

Fairs & Awards:

WESEF 2022

JSBS 2022

STS 2021

Tri County 2021

HHS Symposium 2022, 2021, 2020

Roadkill is one of the leading factors in the decline of local animal populations (Forman et al. 2002), and \$8,388,000,000 are spent annually in the United States to repair damages sustained from wildlife-vehicle collisions (Federal Highway Administration 2008). It is inconclusive whether or not speed limits impact roadkill, and there is a lack of research on the impact of road sinuosity on roadkill (Farmer et al. 2012, Williams et al. 2019, Main et al. 2002). There is also a lack of research on roadkill surrounding nature preserves. To add to the body of knowledge surrounding this topic, a driving survey containing 5 routes and a total of 108.1 miles of road was conducted from fall of 2020-2021 on roads surrounding a preserve in southeastern New York. There were a total of 38 usable observations spanning 11 taxa across the total 20 surveys conducted. There was no correlation between posted speed limit and the rate of roadkill, and no significant correlation between road sinuosity and the rate of roadkill, although there was a slight negative trend. Posted speed limits may not accurately reflect the actual speed of vehicles and road sinuosity is speculated to be linked to higher actual vehicle speeds. Roadkill density was higher on rural roads closer to the preserve. Future research will focus on analyzing land usage on either side of the road, with a larger data set.

Impact of Speed Limits and Road Sinuosity on Wildlife-Vehicle Collisions Surrounding a Preserve in The Suburban Northeastern United States

Introduction

- Roadkill uniformly targets a population, not just the old/weak/young (Forman et al. 2002)
- Estimated \$8,388,000,000/year in vehicle damage (FHA 2008) + 200 deaths and 26,000 injuries (CDC 2004)
- Preserve: area managed to preserve natural features or habitats
- Roads around preserves prevent animals from accessing high quality habitats
- Road sinuosity = not well studied
- Speed limit = commonly studied but inconclusive:



Increased speed limit = increased roadkill risk in vertebrates (Farmer et al. 2012)

Speed limits = no correlation to serval roadkill (Main, M. B., & Allen, G. M. 2002)

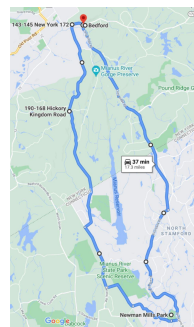
Speed limits = no correlation to roadkill across all species (Williams et al. 2019)

Methodology

Steps

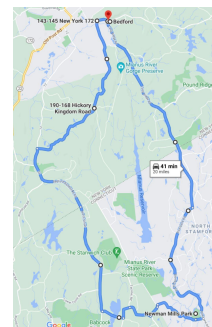
1. Drive and look for roadkill
2. If spotted, pull over
3. Exit vehicle
4. Take photo of roadkill
5. Mark location
6. Upload location and photo to Westchester Roadkill Roundup iNaturalist project

Fig 1. Route A



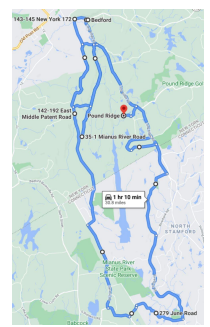
Purpose: roads immediately around preserve

Fig 2. Route B



Purpose: road adjacent to preserve

Fig 3. Route C



Purpose: side/residential roads

Results

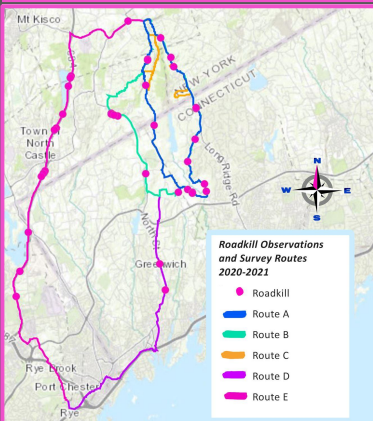


Figure 6. All roadkill observations and routes, color coded

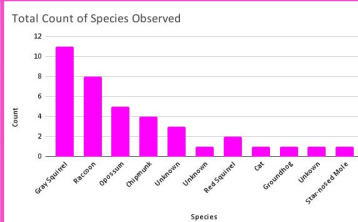


Figure 8. Total count of species observed across all surveys

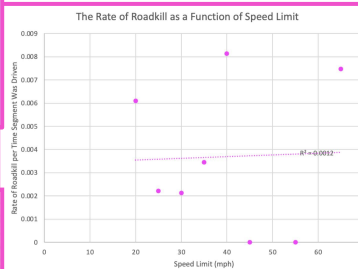


Figure 9. No significant correlation between speed limits and roadkill

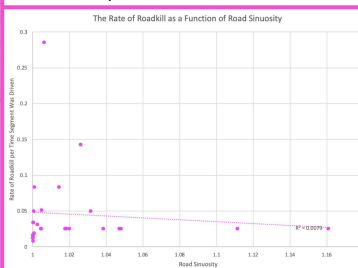


Figure 10. Slight negative correlation between road sinuosity and roadkill

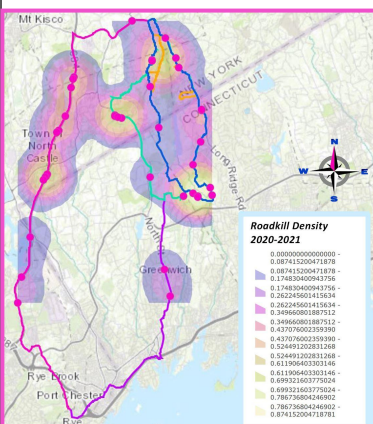


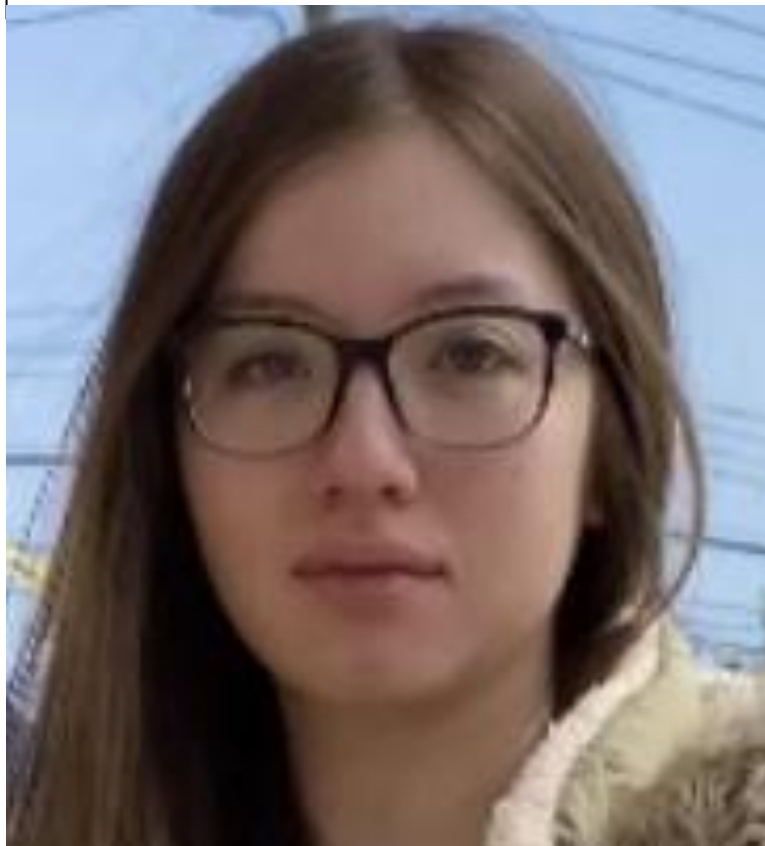
Figure 7. Heat map of roadkill density, with whites and yellows indicating higher densities of roadkill

Conclusion & Future Research

- Hypothesis not supported
- No significant correlation between speed limit and road sinuosity and roadkill
- Future research will analyze land usage on either side of the road and hot spot locations
- For now, education is the best prevention method

Rachel Farias

The Effect of Real life, Video, and Digital Text Environment on Students' Likeness to Lie In An Educational Environment

**Location of Research:**

Harrison High School

Mentor:

Dr. Joanne O'Keeffe

Will be Attending:

Iona College

Intended Major:

Criminal Justice

Fairs & Awards:


JSHS

HHS Symposium 2022, 2021, 2020

In this age of social distancing, people are interacting less face to face, and may be more likely to lie. Whitty & Carville (2008) found that people lie more on text, email, and in other digital settings rather than in-person, because people feel a sense of guilt more often when trying to tell a lie face-to-face. Given COVID-19, it is important to understand students' deceptive behaviors to minimize cheating, and capitalize on learning. Not many studies have shown how students' deceptive motives differ in an in-person setting versus a digital setting. This is a gap where scientists need to do more research. The purpose of this study is to assess whether students are more likely to lie to their authority figure(s) in educational environments over zoom or text (digitally written documents like email, edpuzzle, google docs, chats, etc.) rather than in person. The methodology involves surveying suburban high school students in the Northeastern US. Students will be tasked with rating how likely they are to lie via real life, video, and digital text environment using likert scales. Preliminary results support the hypothesis that students are more likely to lie in digital settings, especially when it involves text where you cannot see your teacher's face.

The Effect of a Digital Environment Versus In-Person Interactions on Students' Likelihood to Lie in an Educational Environment

Introduction

- Leslie Martin, PhD, Wake Forest, states that “60 percent of people can’t go 10 minutes without lying.”
- A **lie** is an assertion that is believed to be false, typically used with the purpose of deceiving someone. The practice of communicating lies is called **lying**. A person who communicates a lie may be termed a **liar**.
- People lie either to deceive, protect themselves, protect others, or to gain something
- Children usually tend to lie more in a school setting to their teachers because they want to impress them or save themselves from punishment (Arky, 2021).
- Adults and children both tell lies for social reasons (Arky, 2021).

Methodology

Gap: Few known studies explore whether high school students are more likely to lie in a digital-text setting than in person (especially to their teachers).

Purpose: To see which educational setting students are more likely to lie in

Hypothesis: Students will lie more frequently in a digital text setting as opposed to students in an in-person/digital video

Subjects Studied:
Suburban High School Students in New York

Variables: Type of Educational Environment, Likelihood to lie, Students
Independent: Type of Educational Environment
Dependent: Likelihood to lie
Controlled: Students

Part 1:
Demographics

Part 2:
Rate likelihood to lie in real life, video, or digital text environment using likert scales

Part 3:
Justify reasons for answers in part 2

How old are you? *

Your gender is? *

What grade are you in? *

☐ Freshman
☐ Sophomore
☐ Junior
☐ Senior

How likely are you to lie in the following situations? *

Never or all the time

Situation	Never	Most of the time	Sometimes	Most of the time	Never
Real life	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Digital text	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Video	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

If you lied that you lied in any of the scenarios above, explain why you lied. If you wouldn't lie in any of the scenarios above, explain why you wouldn't lie.

Using a word or two:

Results & Analysis

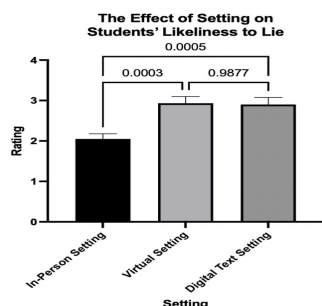


Figure 1: Likelihood to lie: Significant difference between in person vs virtual and digital and students likelihood to lie ($p < .05$). Error bars = SEM (Farias, 2021)

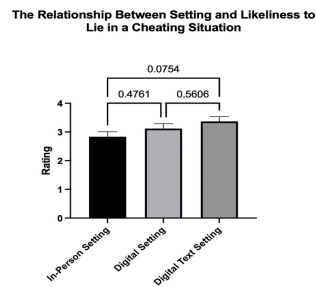


Figure 2: Cheating situation: Significant difference between in person vs digital and students likelihood to lie ($p < .05$). Error bars = SEM (Farias, 2021)

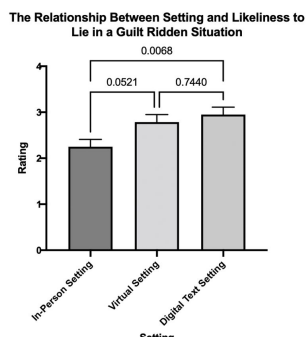


Figure 3: Guilt ridden situation: Significant difference between in person vs virtual and digital setting and students likelihood to lie ($p < .05$). Error bars = SEM (Farias, 2021)

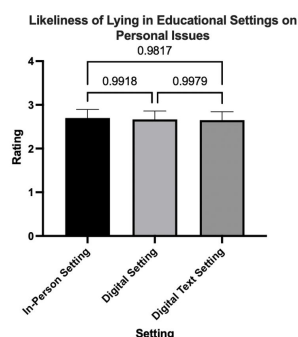


Figure 4: Personal Issues: No significant difference between setting and students likelihood to lie ($p > .05$). Error bars = SEM (Farias, 2021)

Conclusion & Future Research

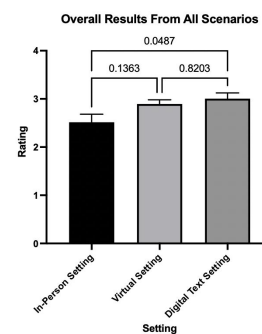


Figure 5: Overall: Significant difference between in person vs digital and students likelihood to lie ($p < .05$). Error bars = SEM (Farias, 2021)

- The hypothesis that students will lie more frequently in a digital text setting was mostly supported.
- Students in an in-person setting were significantly less likely to lie than students in a virtual setting and digital text setting
- Limitation:** Majority students high school = Caucasian: assumption majority of participants were white
- Future research** = other locations in the United States & abroad, and in urban & rural settings and of different races & ethnicities.

Anna FitzPatrick

The Effect of Sculptural Arts Therapies on Sensory Memory Retainment and Visuospatial Functioning

**Location of Research:**

Harrison High School

Mentor:

Ms.Allison Blunt

Will Be Attending:

Lafayette College

Intended Major:

Psychology

Fairs:

Tri County Science Fair 2022

HHS Symposium 2022, 2021, 2020

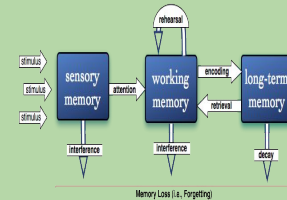
Sensory memory retainment and visuospatial functioning are mechanisms of the brain which impact the ability to manipulate and judge materials based on texture, weight, and spatial distancing. Sensory memory retainment is defined as the transfer of information of five senses from short term memory to long term memory. Visuospatial functioning can be defined as cognitive processes for identifying and analyzing form, details, and spatial relations. The purpose of this study was to determine the impact of sculptural arts therapies on sensory memory retainment and visuospatial functioning. The methods involved 5 students recreating a sculpture over a four week period once a week with a reflection form following the activity. The reflection is based on a likert scale rating which determined the impact on sensory memory retainment and visuospatial functioning. Data was collected and analyzed on the individual and average level for each day to determine the improvement of these aspects over the course of the study. ANOVA testing concluded that a marginal statistical significance was shown. This indicates that there was an improvement in both sensory memory retainment and visuospatial functioning.

The Effect of Sculptural Arts Therapies on Sensory Memory Retainment and Visuospatial Functioning

Introduction

- **Visuospatial functioning:** cognitive processes for identifying & analyzing form, details, and spatial relations.
- **Arts therapies:** use of materials such as paint, clay or other materials to aid cognitive functioning over time.
- **Sensory Memory:**

Figure A: The Process of sensory memory functioning (via: Google)



Cucca et al (2018)

- Multi-functional form of neurorehabilitation
- Better ease of recovery and muscle memory.

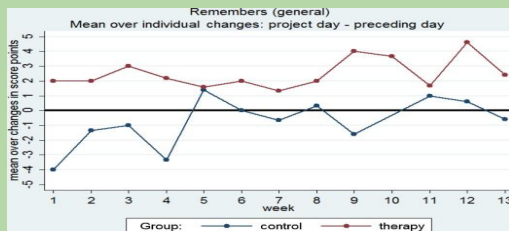


Figure B: The 13-week period indicated improvement in memory in the therapy group more so than the control group.

Methodology

- **Gap In Knowledge:** how can sculptural arts therapies impact sensory memory retainment and visuospatial functioning?
- **Purpose:** To explore the effects of sculptural arts therapies on these specific cognitive functions
- **Hypothesis:** Sculptural arts will improve these cognitive functions through learned muscle memory and ability to recreate a sculpture.

Sample Population: Done through opportunity sampling (Chemistry Club and Art Club).

IV: Use of clay/play-doh
DV: Improvement of Sensory/Visuospatial Functioning
Controls: all participants same age, same time of day, same spacing of study timing.

IRB approval received, Parental Consent forms sent.

Once a week for 4 weeks at 15 minutes per session.



Data analyzed using means and standard deviations.

Completion of a post-study self reflection based off of a created rubric after each session.

Replication of a sculpture based on a picture out of clay/play-doh. (10 minutes)

Results & Analysis

- **Improvement in visuospatial functioning** → ability to determine the shaping of the sculpture.
- **Improvement in sensory memory retainment** → became more efficient.
- **Improvement in both cognitive functions** → molding became easier/more remembered.

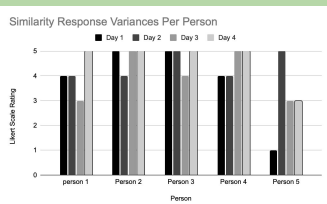


Figure 1.1: Response Variances for Similarity

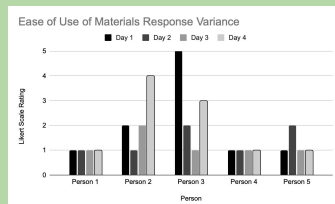


Figure 1.2: Response Variances for Ease of Use of Materials



Figure 1.1: Response Variances for Timing

Conclusion & Future Research

- Expresses improvement in sensory memory and visuospatial functioning.
- Small sample size- 6 participants of the high school age.
- Shows representation of growth in memory over time, specifically sensory memory.
- Applications for patients with Dementia or Alzheimer's.
- May improve deteriorated sensory memory functioning and visuospatial functioning over time.
- Can enable ways to manage psychological distress/ manage mental health conditions.

Figure C: Via: Google



Macarena Hesse

Determining Target Fundraising Practices by Studying Behavioral Shifts in Donor Patterns to Maximize Revenue for Non-Profit Organizations

**Location of Research:**

Harrison High School

Mentor:

Ms. Allison Blunt

Will Be Attending:

Cornell University College of Engineering

Intended Major:

Computer Science

Fairs & Awards:

WESEF 2022- US Air Force Award

JSHS 2022

Regeneron STS 2022

HHS Symposium 2022,2021,2020

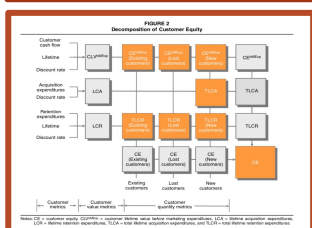
The purpose of this study was to determine which fundraising factors played the biggest role in maximizing revenue. The methodology consisted of creating linear regression models to compare corporate and individual donations, and an ANCOVA to determine pre and post covid differences within the donor data. In addition, an ANOVA analysis was run to examine which mean income range held the greatest amount of average donor lifetime value and the greatest density of donors. The results showed that there was a significant increase in the number of donors and average lifetime giving of individual donors during the COVID-19 pandemic ($p < .01$) and an increase in the quantity of corporate donors. However, the average lifetime giving of corporations remained constant, despite the number of donors decreasing. This shift in trends shows that in times of economic hardships, corporations provide a constant stream of revenue and there is a greater number of new individual donors. A significant number of overall donors in 2020 were first time donors ($p < 0.05$). The nonprofit containing nationwide data showed that individuals residing within areas having a mean income range between 60-70k had a greater average lifetime donation amount over time and therefore are the main target area. However, the nonprofit with regional data from Westchester County had a greater density of donors and greater average lifetime giving in areas with a mean income range greater than 70k. The regional data was proven to be significant and had less variance. The behavioral shifts of corporate donors and individual donors during unexpected economic challenges reveal the ways in which individual donors are more responsive to external factors than their corporate counterparts.

Determining Target Fundraising Practices by Studying Behavioral Shifts in Donor Patterns to Maximize Revenue for Non-Profit Organizations

Introduction

- **4 in 10** Nonprofits Could Close due to COVID-19 related revenue shortages (Levey, 2020)
- Nonprofits currently use third party **Wealth Screening Services** look at philanthropic indicators & wealth markers to form conclusions
- The current system does not take into account current events and does not change to fit new data- instead, it immediately ages out because it relies on outdated information that isn't accurate
- **Customer Lifetime Value** represents the total amount of money a customer is expected to spend in your business during their lifetime

Customer Equity Breakdown Flowchart:



Customer equity = CLV X # of customers- The differences in customer equity flow show predictive results and models of changes in customer equity and overall customer bases (Wiesel et al, 2008).

Methodology

YMCA

ACS

- ACS data is ONLY from Westchester County, while YMCA data shows data from all states who donated to the NYC YMCA office
- 2 Nonprofits shows the model can be used for multiple nonprofit organizations

Independent Variable

Differing Donation Amounts

Dependent Variable

Calculated Future Customer Lifetime Value

Controlled Variables

All data points are from the Northeast US, years 2017-2020, all donors 18 +

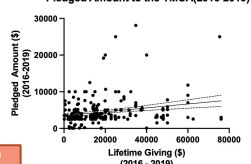
ACS & YMCA Administrators Shared Donor Data from 2017-2020 including individual and corporate donation amounts & lifetime giving

Cleaned Data: Removed all negatives/blanks & corrupt data points

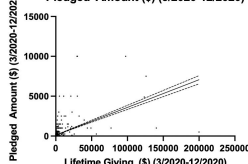
Analyzed Data Using Linear Regressions, ANCOVA, ANOVA, Tukey Analysis & Z-Test for Proportions

Results & Analysis

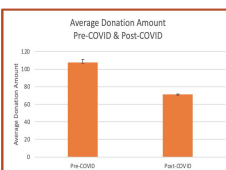
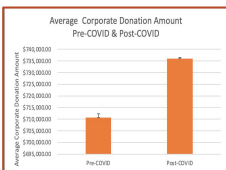
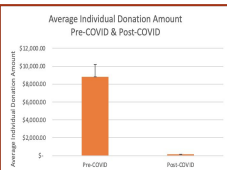
The Relationship between Lifetime Giving and Pledged Amount to the YMCA(2016-2019)



Pledged Amount (\$) (3/2020-12/2020)



An ANCOVA was used to compare the slopes of two linear regression models. The **ANCOVA** results showed a statistical significance ($p < 0.01$) between the Pre-COVID relationship Post-COVID relationship between the variables.



An ANOVA was used to analyze the relationship between average donation amounts pre and post COVID. Figure 2.1 proved to be insignificant ($p > 0.01$) because there was too much variance. Figure 2.2 proved to be significant ($p < 0.05$). Figure 2.3 proved to be significant ($p < 0.01$).

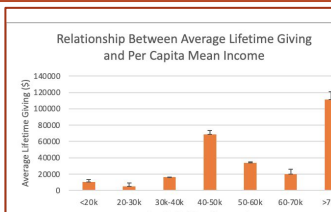
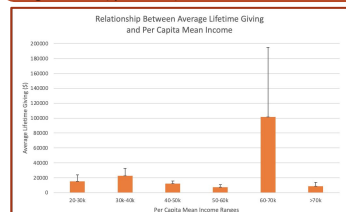


Fig 4.1: no statistical significance ($p > 0.05$) because the variance between income ranges was too great. Fig 4.2: there was a statistically significant ($p < 0.05$) relationship

Conclusion & Future Research

Discussion

- Hypothesis Supported :Donors residing in areas with a greater density of collective donors with a greater customer lifetime value will have a lower acquisition cost → greater density of donors with high retention rates have a lower acquisition cost
- Lower acquisition costs shown by relationship between lifetime giving and per capita mean income
- High retention rates: Corporations have less first time donors → higher retention rates

Future Research

- Adaptable model for different business models and corporations
- Research how the state of the economy impacts different variables in the fundraising process

Maddie Hymowitz

How Increased Knowledge Affects an Inflammatory Bowel Disease Patient's Level of Fear About Their Disease

**Location of Research:**

Harrison High School
Crohn's & Colitis Foundation of America

Mentor:

Dr. Nanci Pittman & Lisa Harding

Will Be Attending:

The University of Texas at Austin

Intended Major:

Neuroscience

Fairs & Awards:

TriCounty 2022
HHS Symposium 2022, 2021, 2020

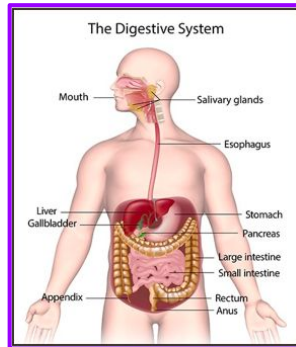
Inflammatory Bowel Disease (IBD) is an ongoing inflammation in one, or all parts of the digestive tract. 2 diseases that fall under the IBD category are Crohn's Disease, and Ulcerative Colitis. Both cause long-lasting inflammation and ulcers/sores in one's large intestine (UC), as well as the rest of the GI tract (Crohn's). IBD may impact up to 3 million Americans each year, and is becoming more prevalent as years go by. Some doctors may speak to or inform a patient's parents about their disease, or not share some or majority of information with their patient because they feel as though they can't handle it, or don't need to know. This may lead to patients feeling scared, or fearful about their disease because they may "fear the unknown" about their prognosis. Moreover, some of those patients may prefer to be informed about their disease as it may make them feel less fearful about their diagnosis and prognosis. With more information, they may be able to make more sense of their disease and feel less in the dark. As these patients get older, I am curious to see if the amount of information they have changes their general fear levels. This is essentially what this experiment aims to assess; whether more information about an IBD patient's prognosis leads to more or less fear. By identifying if these factors cause more or less fear in patients, doctors will be able to treat their patients giving them the knowledge that the patient feels that they want. In other words, the doctors will have the patient's best interest in mind by knowing these factors.

How Increased Knowledge Affects an Inflammatory Bowel Disease Patients Level of Fear About Their Disease

Maddie Hymowitz

Introduction

- **What is IBD?**
 - An ongoing inflammation in one or all parts of the digestive tract
 - Crohn's Disease
 - Ulcerative Colitis
- **IBD Relevance/Facts**
 - Impacts up to 3.1 million adults in the US
 - Meds for treatments à short-lasting, no cure
 - Surgery is the only "cure"
 - Some symptoms include, abdominal pain, diarrhea, fatigue, fever, weight loss, anemia
 - Usually diagnosed before the age of 30
- **Treatments**
 - Medications are used, but are all short-lasting
 - No cure
 - Surgery is the only "cure," but not for all IBD



Methodology

Gap in Knowledge: Many studies have been done to test the knowledge of patients on various diseases, but not IBD patients

Hypothesis 1: IBD patients will feel less fearful about their disease and condition if they have more knowledge.

Hypothesis 2: As time since initial IBD diagnosis increases, fear levels should decrease.

Hypothesis 3: If the majority of knowledge about an IBD patient's disease comes from their doctors, they will feel less fearful

Literature Review

Conceive of Research Question

Design Survey

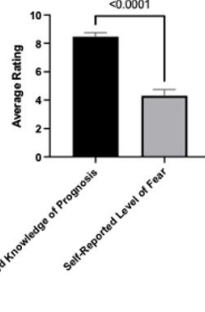
IRB approval

Analyze results

Draw Conclusions

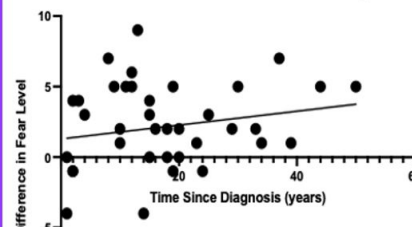
Results & Analysis

Relationship Between Knowledge of Prognosis and Level of Fear



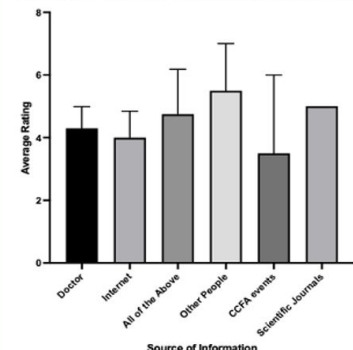
Significant correlation between knowledge of prognosis and level of fear ($p < 0.0001$)

Difference in Fear Level from Time of Diagnosis



Moderately significant linear correlation between time since diagnosis and fear level ($r = 0.1847$) ($r^2 = 0.03412$).

Relationship Between Source of Information and Level of Fear



No significant relationship between source of information and level of fear

Conclusion & Future Research

Figure 1

- Hypothesis supported
- IBD patients will feel less fearful about their disease and condition if they have more knowledge

Figure 2

- Hypothesis not supported
- Time since initial IBD diagnosis did not significantly affect the fear levels

Figure 3

- Hypothesis not supported
- The source of knowledge about an IBD patient's disease does not affect the fear levels

- Dive more into the psychological aspect - emotions
 - WHY do patients feel fear?
 - What other emotions do IBD patients feel?
 - Is fear most prevalent in IBD? If not, what emotion is?
- Test a larger population with people not involved in CCFA
- Conduct a study with adolescents
 - Would their responses be different than adults?

Jack Kelly

Quantifying Linguistic Polarization for Congressional Representatives Facing Primary Challengers: A Random Effects Logit Regression Approach

**Location of Research:**

Harrison High School / Home

Mentor:

Professor Christopher Stout, PhD

Will Be Attending:

Harvard College

Intended Major:

Government

Fairs & Awards:

2022 Regeneron ISEF Finalist

WESEF 2022 - Top of the Fair, 1st Place in
Behavioral and Social Sciences
HHS Symposium 2022, 2021, 2020

Linguistic polarization is a change in frequency of policy references in a representative's lexicon. When incumbent representatives face challengers, they may change their speech patterns to distinguish themselves to voters. Since Sulkin (2009) found a strong correlation between how representatives speak and how they vote, linguistic polarization could lead to policy differences. This study used a random effects logit regression to see if progressive primary challengers linguistically polarize Democratic Congressional incumbents. Because Kamarck and Podkul (2018) showed a 151% percentage increase of progressive Democratic House candidates from 2016 to 2018, the 116th Congress was chosen. Twitter was used as the data source because of the brevity and frequency of tweets. A total of 601,304 tweets from 410 representatives were coded for progressive language using a dictionary based approach. The dictionary had 194 terms (identified from 14 websites) and 50,722 total tweets were coded as progressive. 30 progressive challengers were included since they received $> 5\%$ of the votes in a primary and a major progressive endorsement. A regression was run for 30 incumbents facing viable challengers that looked at percentage of progressive tweets from incumbents (DV) before and after the challenger was endorsed (IV). Results showed incumbents had a 27% decrease in progressive language after a challenger entered the race ($p < .05$), a decrease 3x greater than a control group of randomized Democratic incumbents. One implication was that progressive challengers might have a moderating effect on Democratic incumbents as they aim to establish a distinct electoral path to victory.

Quantifying Linguistic Polarization for Congressional Representatives Facing Primary Challengers: A Random Effects Logit Regression Approach

Incumbent:

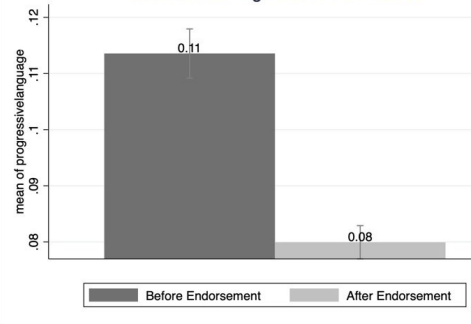
- Current elected official
- ❖ Facing challenger can result in polarization
- Linguistic polarization:**
- Changes in the frequency of policy references
- ❖ Can be measured using Twitter (Stout 2021)
- ❖ Can lead to policy shifts (Sulkin 2009)

Gap: Minimal research on progressive linguistic polarization in the 116th Congress

Purpose: To determine if Democratic Congressional incumbents will linguistically polarize when facing viable progressive candidates

Hypothesis: If Democratic congressional incumbents face viable progressive primary challengers, they will linguistically polarize to speak more frequently about progressive issues

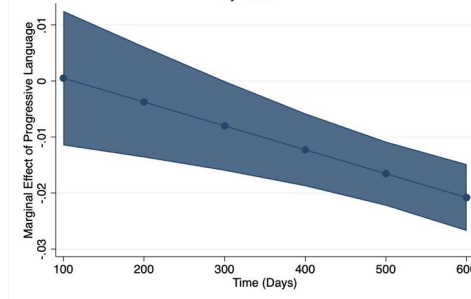
Percent of Progressive Language Tweets Before And After a Progressive is Endorsed



Regression:

- ❖ 27% decrease in progressive policy references ($p < .01$)
- ❖ 3x decrease of the control group

Effect of Endorsement on Progressive Language By Time



Time interaction of regression:

- ❖ As time progresses, significantly more moderation in language occurs ($p < .01$)

METHODOLOGY



Selection of Participants

Experimental: 30 incumbents had viable challengers

Control: 30 randomized incumbents



Creation of Dictionary

Green New Deal
GND
Green New Deal Resolution
#GreenNewDeal
#GND
#GreenNewDealResolution
Sustainable

194 progressive terms generated from 14 websites



Cull Data + Regression

601,304 tweets coded by dictionary approach (8% progressive) → Regression before/after endorsed

Images: Pngkit (2021), PinClipart (2021), Kelly (2021)

CONCLUSION

Hypothesis = Rejected

Incumbents notice primary challenger

Take the path of a distinct electoral appeal



Behavior changes, there is a **moderation** of language

APPLICATION

Political: Polarization might not be as extreme as we think

Social science: Quantifying seemingly unquantifiable behavior

MAJOR RESULTS

Danny Mandell

A Study on the Adoption of Artificial Intelligence into Healthcare



Location of Research:
Harrison High School

Mentor:
Mr. Randy Gunnell

Will Be Attending:
Boston University

Intended Major:
Neuroscience

Fairs:
JSHS 2022
HHS Symposium 2022, 2021, 2020

Artificial Intelligence is a system of algorithms that are used to create a definite conclusion to a specific question. These systems can be used in various fields such as business, farming, marketing, and medicine. Specifically, in medicine, the technology can be used to diagnose, treat, or classify diseases more efficiently than humans. With the use and need of Artificial Intelligence in medicine rapidly increasing, it was important to determine exactly who uses the algorithms and to what extent those medical professionals are using them. To achieve this, a questionnaire was sent to various medical organizations, hospitals, and specific medical professionals where the participants were asked questions regarding their specialty, knowledge of Artificial Intelligence, and types of Artificial Intelligence they use. Then, a comparison was made between the medical professionals in specific practices and those who are general practitioners. After a careful analysis, it was determined that most medical professionals know what the term “Artificial Intelligence” means in the context of medicine, yet there are still some who don’t. Those who don’t mostly work in hospitals rather than offices, yet there is a variance between those who know what the term means. It was found that the number of respondents who use Artificial Intelligence is somewhat even to the number of respondents who don’t know what the term means. Furthermore, how long ago Artificial Intelligence was implemented for those who use it differs as some have been using the algorithms for more than 3 while others have been using it for less than a year. Lastly, it was found that Artificial Intelligence was commonly appreciated in the medical field as it improved the quality of the medical professionals’ work. The results support the argument that there is an overall knowledge gap of Artificial intelligence in the medical field as many respondents stated that they knew what the term “Artificial Intelligence” meant in the context of medicine, yet stated types of technology that doesn’t classify as Artificial Intelligence when asked what specific types they used. However, there is a common understanding that using the technology improves the lives of medical professionals and makes their jobs easier.

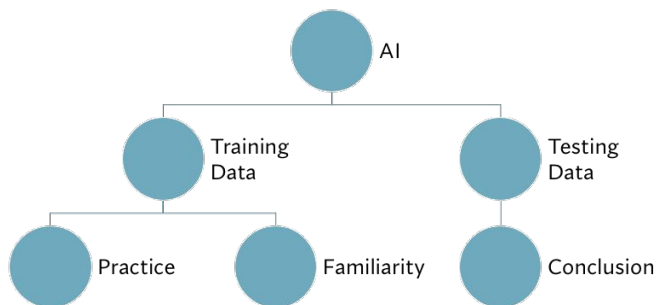
A Study on the Adoption of Artificial Intelligence into Healthcare

Introduction

Artificial Intelligence

- System of algorithms
- Uses data to create conclusions
- Oftentimes used in medicine

How AI Formulates a Conclusion:

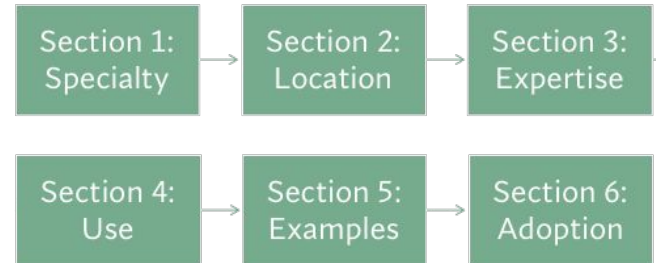


AI Methods

- Efficient
- Can hold large data sets

Methodology

Survey Construction



Survey Distribution

Step 1:

- Medical Organizations

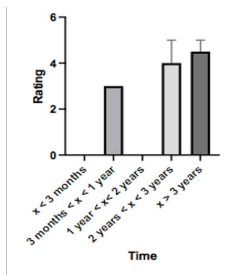
Step 2:

- Offices/Hospitals

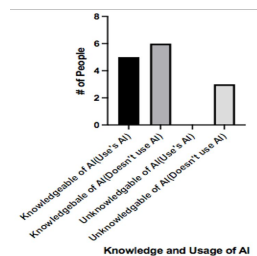
Step 3:

- Opportunistic Sampling

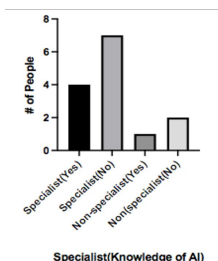
Results & Analysis



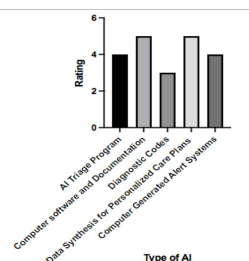
- Time ↑ = Rating ↑
- AI has mostly aided professionals



- Many professionals learn AI
- Still a lack of usage



- Most lack knowledge
- No matter the speciality



- Common consensus
- AI is useful for patients

Conclusion

- First hypothesis – not supported.
 - Most participants did not use AI
- Second hypothesis - supported
 - Average rating of usefulness - 4.2/5
- More knowledge of AI is needed
 - New and old doctors need to be taught how to use AI methods
- More implementation of AI is needed
 - Can allow for medical conclusions to be made far quicker

Future Research

- Use of in-person interviews
 - Would allow for further inquiries to be made
- Exploration of whether age plays a role in the implementation of AI
 - Older participants may be better suited with manual techniques

Gabriela Marraccini

Evaluating the Relationship Between a Human's Mood and a Pet/Companion Dog's Emotional State.

**Location of Research:**

Harrison High School

Mentor:

Dr. James Serpell & Dr. Katherine Houpt

Will Be Attending:

Boston University

Intended Major:

Biology

Fairs & Awards:

WESEF 2022

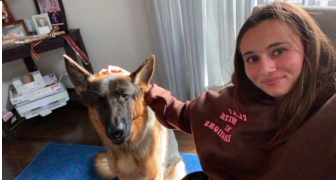
JSHS 2022

HHS Symposium 2022, 2021, 2020

The purpose of this study was to survey dog owners to determine if they report a relationship between their moods as measured by the Positive and Negative Affect Schedule (PANAS) and their pet dog's body language and behaviors. The survey consisted of three parts. Part 1 required the participants to take the Positive and Negative Affect Score (PANAS) test. Part 2 asked the owners to fill out basic demographic information about themselves and their dog. Part 3 asked participants to identify which doggie language image best represents their animal's body language. The results showed that there was a significant positive correlation between owner mood and pet dog emotional state. There were significant differences and a large effect size between current human positive affect and reported total dog positive affect ($p < .05$) and the negative moods were also significantly correlated ($p < .05$). When humans also reported when they felt angry, the dog's body language was significantly more likely to be identified as anxious ($p < .05$); and when humans reported that they felt happy, their dog's body language was significantly more likely to be identified as overjoyed ($p < .05$). However, when the owner was stressed/anxious the dog was identified as curious but not anxious. This study verified that dogs are influenced by their owner's mood. If the owner consistently exhibits negative moods, such as anger or sadness, in front of the dog then the dog may begin to feel similarly and exhibit negative behaviors.

Evaluating the Relationship Between a Human's Mood and a Pet/Companion Dog's Emotional State

Introduction



- Unclear what this relationship looks like from the dog's perspective.
- Ben-Shwarzburg et al (2020) found that evolution equipped dogs with the ability to bond and interact
- Domestication Hypothesis:** Dogs evolved an inherent sensitivity to human gestures that their non-domesticated counterparts do not share.
- Personality:** Individual thoughts, feelings and behaviors that remain relatively consistent throughout life.
- Mood:** Emotional feeling in the moment influenced by external phenomena.
- Hypothesis:** Reported "doggie language" will directly correlate with reported human emotional state.

Methodology

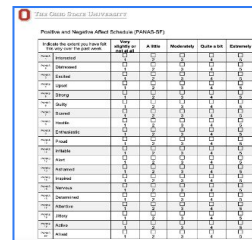
Participants

Gender	Race/Ethnicity	Age	Breed	Location	Medical Conditions	Age	Gender
Female = 85.4% Male = 14.6%	White = 86.9% Hispanic/Latino = 9.5% Black = 0.7% Asian or Pacific Islander = 2.9% Other = 2.9%	>40 = 79.6% 30-40 = 13.9% 20-30 = 5.8% (8) 18-20 = 0.7% (1)	Purebred = 43.8% Mutts = 28.5% Designer Breed = 24.1% Unknown = 3.6%	Breeder = 43.8% Rescued = 30.7% Shelter = 8.8% Pet Store = 8.8% Other places = 7.9%	No = 83.2% Yes = 16.8%	2-5 = 34.3% >5 = 24.8% 0-2 = 23.4% 6-8 = 17.5%	Male = 54.7% Female = 45.3%

Variables

Independent	Dependent	Controlled
Human Affect/mood (PANAS Test)	Doggie Affect Ratings on a scale of 1-5	Participants completed the survey while in the presence of their dog All participants who indicated that they were not in the same space as the dog were eliminated from the study

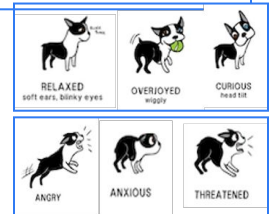
Part 1: Positive and Negative Affect Schedule (PANAS)



Part 2: Demographic Questions

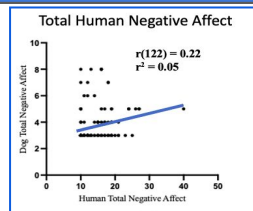
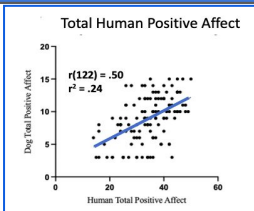
- * How many other people are present in the house?
- * How many other dogs are present in the house?
- * How many dogs have you previously owned?

Positive

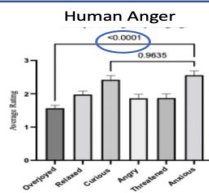


Part 3: Identifying "Doggie Language" Negative images

Results & Analysis



Significant correlation between Current Human Positive and Negative Affect and Reported Affect for Pet Dog ($p < .05$)



Significant difference between the dog being identified as curious versus anxious ($p < .01$)

Significant difference between the dog being identified as anxious versus overjoyed ($p < .01$)

The dog identified as overjoyed significantly more than all three negative dog moods: angry, anxious and threatened ($p < .01$)

Conclusion

- Hypothesis Supported** → Reported "doggie language" did correlated with the human emotional state as reported on the PANAS.
- Results of this study could potentially change the understanding of the relationship between humans and dogs.
- Owner consistently exhibits a negative mood, such as anger or sadness, in front of the dog then the dog may begin to feel similarly and exhibit negative behaviors.

Future Research

- Directly observe human dog interactions.
- Examine the dogs brain activity using an fMRI.
- Test other indicators such as blood pressure and cortisol levels of the dog.
- Test a more diverse population.
- Explore other pet and human relationships in other household animals.

Graham Napack

Inducing Hypocrisy to Motivate Socially Responsible Behaviors
During the COVID19 Pandemic



Location of Research:
Westchester County

Mentor:
Allison Blunt

Will be Attending:
Williams College

Intended Major:
Undecided

Fairs & Awards:
Symposium 2022, 2020

Although public health officials have known about effective methods for reducing transmission of COVID-19 since the start of the pandemic, motivating the widespread adoption of methods like mask-wearing among the necessary portion of the public has posed a challenge. This study attempted to motivate higher compliance with measures critical in reducing COVID-19 transmission by motivating individuals to alter their mask-wearing behavior. To achieve this goal this study utilizes the theoretical framework of the Hypocrisy Paradigm, a variation of cognitive dissonance theory that intentionally induces a state of dissonance in participants between their beliefs and their actions, to motivate behavioral change. The hypothesis was that participants who had experienced dissonance through induced hypocrisy would change their future behaviors. The methodology involved testing 4 experimental groups where the public commitment of participants to following mask-wearing guidelines as well as the participant's awareness of their own past failures to follow such guidelines was manipulated. Results revealed that the participants in the hypocrisy state who were previously failing to consistently practice socially responsible behavior during the pandemic were more likely to correct these behaviors and adhere to mask guidelines for the three-week period of time following the study. These results indicated that the Hypocrisy Paradigm could be effectively utilized to change behavior during the COVID19 pandemic and in other public health emergencies where widespread public cooperation is necessary.

Inducing Hypocrisy to Motivate Socially Responsible Behaviors During the COVID19 Pandemic

Introduction

- This study utilizes the hypocrisy paradigm developed by Leon Festinger which takes advantage of the negative emotions associated with assuming a hypocritical position in order to motivate change.
- This study applies this paradigm to the COVID19 Pandemic by utilizing the dissonance between public awareness of proper methods for combating the virus and the lackluster implementation of such measures

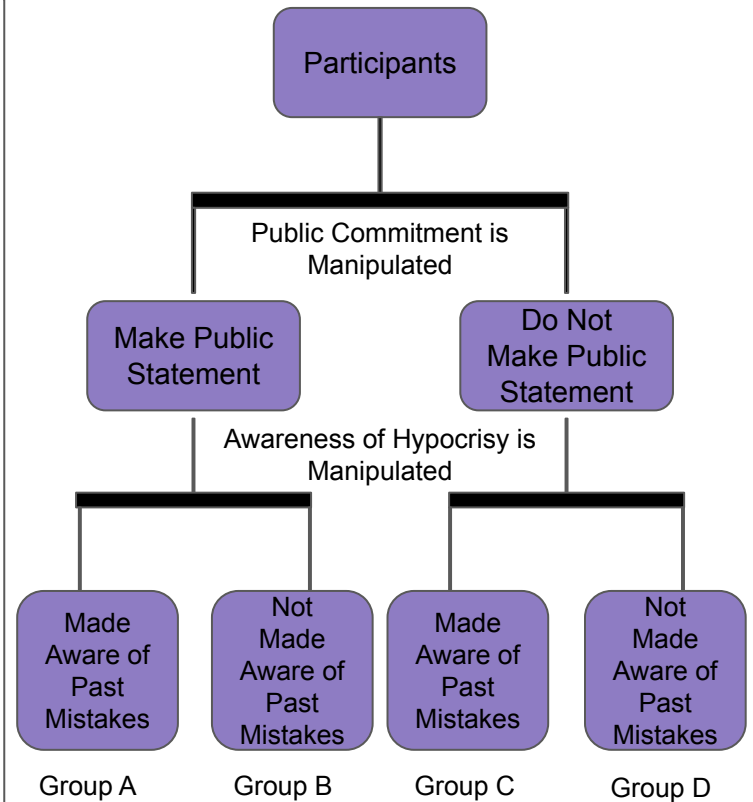
Goal

Motivate more socially responsible behavior by improving mask wearing behavior

Hypothesis

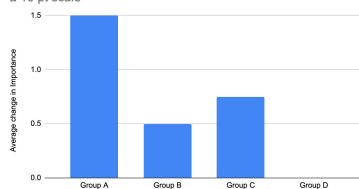
If hypocrisy is induced in participants then they will be more likely to adopt more socially responsible behaviors.

Methodology



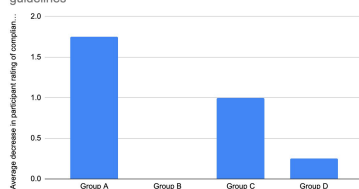
Results & Analysis

Average change in participant rating of importance in points on a 10 pt scale



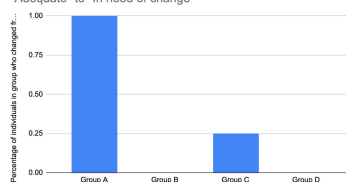
Group A displayed a much greater increase (1.5 points) in their belief in the importance of following proper mask guidelines.

Average decrease in participant rating of compliance to mask guidelines



On average, Group A's rating of their past behavior dropped by 1.75 points.

Percentage of individuals in group who changed from "Adequate" to "In need of change"



Group A demonstrated the highest rate of participants changing their description from "Adequate" to "In need of change"

Conclusion & Future Research

Conclusions

- The large increase in how Group A, who made a speech and was made aware of past mistakes, viewed the importance following mask guidelines compared to other experimental groups is an indicator that the experiment had a positive effect on their future behavior.
- The comparatively large decrease in how Group A rated their own past behavior after the experiment indicates that inducing hypocrisy had the intended effect of participants rejecting past behavior.
- Participants group a who originally classified their behavior as "adequate" were more likely change their description to "in need of change" after the experiment, a strong indicator that behavioral change was successful

Applications and Future Research

- The effect should be studied over a longer period of time to see if it created lasting change
- A method for inducing hypocrisy on larger groups of people should be investigated
- Could be applied to future public health crisis that require mass public cooperation

Katie Pflieger

The Modification of the BNM-III-170 inhibitor
for the purpose of a HIV vaccine

**Location of Research:**

Performed Virtually through Drexel University

Mentor:

Dr. Cameron Abrams

Will be attending:

Barnard College of Columbia University

Intended Major:

Biology

Fairs & Awards:

WESEF 2022- 3rd Place In

Bioinformatics/Computational Biology

JSHS 2022

Regeneron STS 2022 - Top 300 Scholar

HHS Symposium 2022, 2021, 2020

Mellilo (2016) used computational drug design to create BNM-III-170, a small and potent inhibitor that effectively binds to GP-120, the only protein presented during HIV transmission. However, due to the massive size of the binding site of GP-120 and existence of small, specific cavities, BNM-III-170 struggles to interact with essential atoms required to ensure that HIV would not attach successfully. This study used computer aided drug design to test HIV-1 entry inhibitor leads based on small molecule CD4 mimetics and focused on the improvement of the BNM-III-170 inhibitor for the HIV entry enzyme GP-120. This study involved computational synthesis of functional groups to BNM-III-170 to hypothesize the atomic interactions between inhibitor and binding site. The hypothesis was twofold: 1) Adding a bent seven-membered ring to the distal side of the indane enabled a better fit of the compound into the gp120 binding site 2) Replacing indane with purine enabled new drug-protein interactions. The methodology entailed an analysis of the binding site, the selection of functional groups from FDA-approved non-HIV antiviral drugs and a computational synthesis of the functional groups on BNM-III-170. The results showed that when indane was replaced by purine, stronger interactions were formed between the guanidinium moiety and the protein and the aspartic acid 368 and the protein. Interactions with ASP 368 were previously unachievable by the protein, however ASP 368 may significantly strengthen the inhibition of HIV. The results are promising as the strong interactions between the protein and ASP 368 imply strengthened inhibitory abilities.

The Modification of the BNM-III-170 molecule through the use of computational drug design for the purpose of a HIV vaccine

Introduction

HIV: Human Immunodeficiency Virus

- Depletion of CD4 in order to weaken the human immune system
- Over 35 million cases of HIV today
- Currently no vaccine due to: Rapid mutation rate

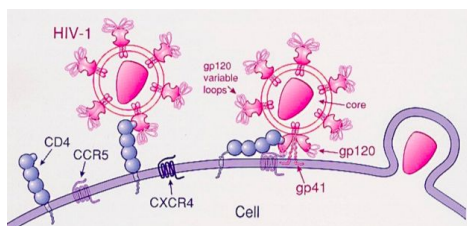


Figure 1: Transmission of HIV to the body
HIVinfo.gov. (n.d.). National Institute of Health.

- Glycoprotein envelope (GP-120) binds to CCR5 to get to CD4 (Kwong 1998)
- Production of synthetic inhibitors for gp-120
- BNM-III-170 went through extensive testing and was seen to be effective in primates (Mellilo 2016)

Methodology

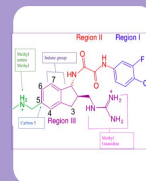


Fig 2: Computational view of BNM-III-170 as divided and labeled in regions I, II, and III
Abrams, C. F. (2021, September 21)

Analysis of the GP-120 binding site and structures to determine issues with binding process

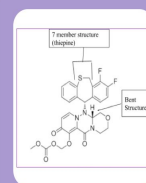


Fig 3: Computational view of 7-membered structure
Abrams, C. F. (2021, September 21)

Selection of functional groups that could be additive in improving the BNM-III-170 inhibitor from molecules that have:

- molecular weight between 300 and 2000 grams/mol
- non-specific and hydrophobic
 - FDA approved
 - non-HIV antiviral

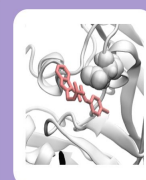


Fig 4: Computational synthesis of improved BNM-III-170 based inhibitors
Abrams, C. F. (2021, September 21)

Computational synthesis of the improved BNM-III-170 based inhibitors and analysis of the success of the binding

Results & Analysis

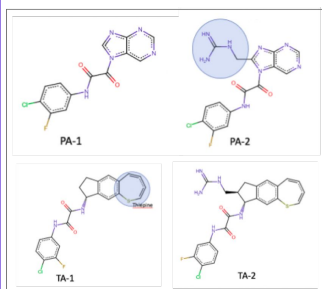


Fig 5: Computational view of TA-1, TA-2, PA-1 and PA-2

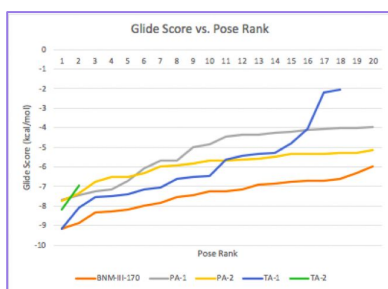


Fig 6: Graphical analysis of free binding energy scores

Ranked	Glide Scores (kcal/mol)				
Pose	BNM-III-170	PA-1	PA-2	TA-1	TA-2
1	-9.155	-7.706	-7.726	-9.188	-8.162
2	-8.85	-7.449	-7.346	-8.074	-6.983
3	-8.31	-7.251	-6.753	-7.529	
4	-8.297	-7.149	-6.526	-7.516	
5	-8.163	-6.733	-6.501	-7.376	
6	-7.998	-6.088	-6.305	-7.165	
7	-7.85	-5.694	-5.997	-7.072	
8	-7.542	-5.674	-5.92	-6.997	
9	-7.448	-4.975	-5.827	-6.52	
10	-7.258	-4.859	-5.702	-6.456	

Fig 7: Results of the free binding energy scores

Conclusion & Future Research

- TA-1 had an optimal lower docking score than BNM-III-170 in pose 1
- The lower optimal docking score indicates that TA-1 was successful in conforming to the protein
- TA-1 may go through further non-hypothetical testing for the purpose of determining if it could be a better inhibitor than BNM-III-170 beyond conforming to the protein

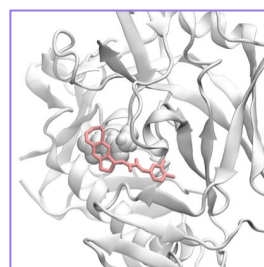


Fig 8: TA-1 conforming to protein
Abrams, C. F. (2021, September 21)

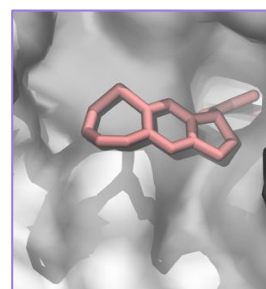


Fig 9: TA-1 conforming to protein – mesh model
Abrams, C. F. (2021, September 21)

- This study eliminates a general area of functional groups that may not be effective in improving the BNM-III-170 molecule
- This study demonstrates a possible functional group that may lead to improvement
- This study has the potential long-term impact, with further testing, of creating an effective HIV vaccine

Amelia Rasmussen

A Data Analysis of Mutated Genes in Breast Cancer and Ovarian Cancer in Women under 40



Location of Research:
Harrison High School

Mentor:
Allison Blunt

Will be Attending:
UC San Diego

Intended Major:
BioMedical Engineering

Fairs:
TriCounty
HHS Symposium 2022, 2021, 2020

CBioPortal is a system that allows medical practitioners to put deidentified data into a portal which can be directly analyzed by researchers and is generally available to the public. This is a revolutionary system which allows for more data to be collected and analyzed than ever before. The advent of cBioPortal which allows for the accumulation of patients data from medical practitioners all over the United States, trends may be more easily spotted. The purpose of this study was to use data from cBioPortal to determine the relationship between age, histological grade and ovarian and breast cancer patients and gene expression. To what extent can genetic data compiled in cBioPortal help facilitate an understanding of biological processes to aid in the detection and treatment of cancer. The results will demonstrate the use of cBioPortal to identify trends that can lead to more effective treatment plans. cBioPortal by providing a system for sharing data on cancer genomics offers opportunities for collaboration between researchers and medical practitioners. Making this data more readily available will hopefully increase future survival rates.

A Data Analysis of Mutated Genes in Breast Cancer and Ovarian Cancer in Women under 40

Introduction

Obtaining cancer data is difficult, many private companies have private databases

Data that has been published is generally outdated and oftentimes is no longer relevant

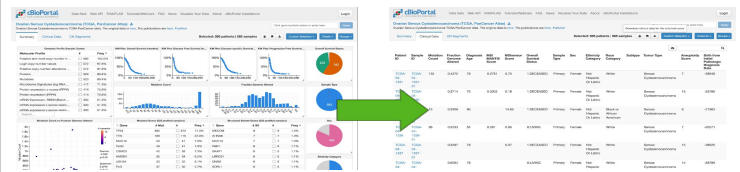
Data can be used to determine trends & advance medicine while making more personalized decisions for patients (Innovations in Care Delivery, 2018).

cBioPortal is a system that allows medical practitioners to put deidentified data into a portal which can be directly analyzed by researchers and is generally available to the public

The geographic range of data and the ability to sort by so many different factors allow for trends that the medical community was previously unaware of

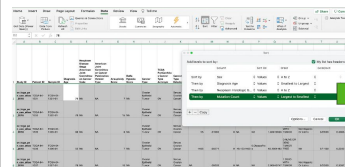
Many times treatments are optimal for white patients (due to available data) because environmental factors and ethnicity aren't always taken into consideration when treating other patients. This leads to lower survival rates (Immune-Related Gene, 2020)

Methodology



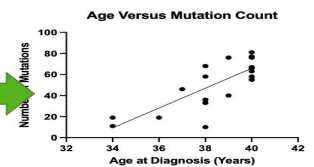
Step 1: Identify all data found in cBioPortal for Breast Cancer or Ovarian Cancer

Step 2: Download the raw data



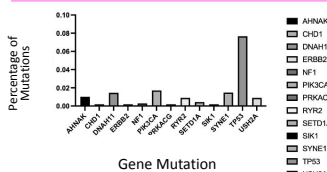
Step 3: Open into excel and clean the data to make sure that all data points where viable. Sort data based on gene mutation, count, grade, and survival status

Step 4: Plug analyzed data into graphpadprism and select most appropriate graph



Results & Analysis

Most Frequently Mutated Genes in Breast Cancer



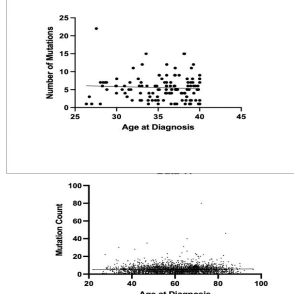
The three most frequently mutated genes in breast cancer:

TP-53

PIK3CA

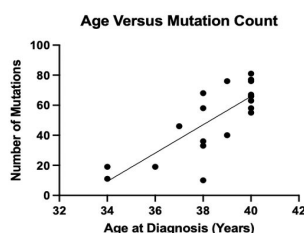
DNAH11

Ovarian Cancer



No correlation between age and mutation count

Breast Cancer



$r = .7899 \rightarrow$ high correlation between age and mutation count

Conclusion & Future Research

Further research should be done to determine why the number of mutations varied significantly ($p < .05$) between age and breast cancer and ovarian cancer patients

Further research with a larger sample size and with a wider range of estrogen based cancers such as endometrial cancer

Look at differences in gene mutations in younger and older populations of women

Look on a more global scale instead of focusing on US

How do different environmental factors impact gene expression and mutation

Based on most frequently mutated genes a better treatment plan can be formulated

Age and mutation count are not necessarily correlated in certain types of cancer

TP53 mutations are found in high concentrations in both BC and OV

Morgan Remeza

Assessing the Impact of Climate Change Using High Power Rocket Aerial Imagery

**Location of Research:**

Torrey Potter Farms, Potter, NY

Mentor:

Fred Kepner
Jim Livingston
Ana Hiraldo-Gomez
Oliver Jia-Richards

Will be Attending:

Cornell University College of Engineering

Intended Major:

Mechanical & Aerospace Engineering

Fairs & Awards:

WESEF 2022 - 2nd Place (Climate),
Environmental Perspiration Award
2022 JSHS 3rd place, qualified Upstate JSHS
WESEF 2021 - 3rd Place (Math)
HHS Symposium 2022, 2021, 2020

While dramatic weather events such as hurricanes prompt important discussions, the long-term effects of climate change can be more damaging, affecting agriculture, infrastructure, industry, biodiversity, with many effects harder to reverse. Therefore, it is critical to have a cost-effective method to monitor changes in geography continuously for early detection and loss prevention. High power rockets (HPR) can contribute to more frequent and cost-effective collection of aerial imagery needed for climate analysis. While commercial methods for collecting aerial imagery may cost hundreds-of-thousands of dollars at a minimum, HPR systems cost as little as \$100. To test whether HPR can be effective for aerial imagery collection to quantify climate effects, imagery was gathered from 16 self-performed HPR launches that occurred between 2016 and 2021. The images were converted into tile layers, and the area of a wetland and evergreen forest was analyzed in ArcGIS. As a control, the areas of the two points of interest were measured from satellite imagery. The results showed the wetland area increased with a $0.54 r^2$ and the evergreen forest area decreased with a $0.35 r^2$, which is an expected result of precipitation and temperature increases, supporting the hypothesis. Furthermore, comparing satellite and HPR imagery area measurements showed only minor differences. These findings support the use of HPR imagery for analysis of climate change impacts and the establishment of a crowdsourcing platform for rocketeers globally to share imagery at a high frequency to track environmental changes while increasing community engagement with climate science.

Assessing the Impact of Climate Change Using High Power Rocket Aerial Imagery

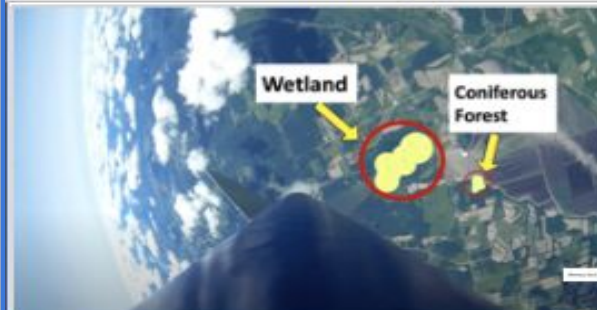
Introduction

High Power Rockets (HPR)



- Simple components
- 2,000' + launches
- Total cost >\$100
- Easy camera integration

HPR For Imagery



- Broad coverage of geography
- High frequency aerial imagery
- Affordable to average person & widely available

Methodology

Gap

- Is HPR imagery capable of producing accurate geographic information for climate research?
- Is it a viable alternative to more expensive aerial surveying methods?

Purpose

Use HPR imagery to quantify changes in wetland and forest areas. Confirm rocket imagery accuracy by comparing satellite imagery. Assess geographic changes as function of climate

Hypothesis

HPR imagery will clearly show changes in local geography that will correlate with climate trends at over 90% accuracy

Data Analysis Methods

- Establish linear regression models
- Analyze wetland & forest trends
- Compare vs precipitation

Results & Analysis

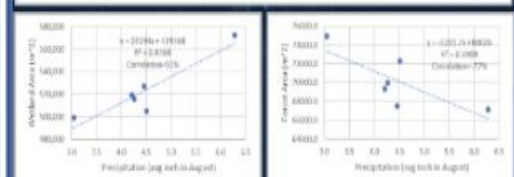
2016 vs 2021 HPR Data: Wetland Expansion



2016 vs 2021 Observation: Evergreen Forest



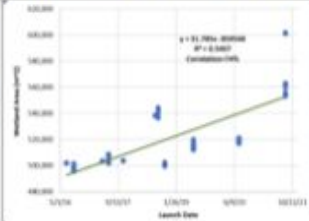
Predicting Geographic Changes



Strong correlation between precipitation & geographic feature area

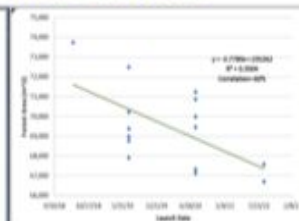
Wetland Area Increased Over Time

- Wetland area increased about 31.8 m² per year, with 74% correlation



Forest Area Decreased

- Decreased about 3.8 m² per year, with 60% correlation



Verification of Accuracy: Satellite vs HPR



Conclusion

Hypothesis Supported

- HPR imagery derived data was >95% accurate

Next Steps

- Raise community awareness & involvement for environmental toolkit and crowdsourcing platform

Future Research

- Develop software to quantify boundaries of geographic features to improve accuracy
- This will require a program that can process pixel coloration while taking into account the effects of variable cloud cover.

Yuiko Suzuki

The Development and Use of the App “Wish List With Friends” or “WLWF” to Increase Feelings of Social Connectedness Amongst Adolescents



Location of Research:
Home/Harrison High School

Mentor:
Mr. Michael Klein

Will be Attending:
University of Wisconsin

Intended Major:
Chemistry

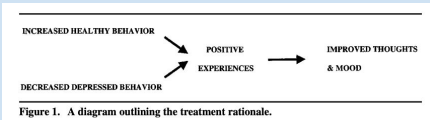
Fairs & Awards:
WESEF 2022 - Honorable Mention
NYSSEF 2022
Westlake 2020
HHS Symposium 2022, 2021

During lockdown due to COVID19, the CDC reported that 60% of more than 5,400 adolescents reported experiencing feelings of social isolation. Since over 90% of US youth report having access to social media (NCBI, 2020), many adolescents use social media to connect with their friends and family and/or express themselves. While adolescents use social media to feel connected to others, few known vehicles exist for adolescents to reconnect after experiencing social isolation. An app called “Wish List With Friends” was developed using IOS Swift Code version 12.5.1 to encourage behavioral activation among adolescents. The app allowed peers to create a wish list of activities to complete together and then to upload photos of themselves as they accomplished each item on the wish list. 13 students were then surveyed to determine their feelings of social connectedness after exposure to the app. Participants were required to watch a 5 minute video that showed the app and how it worked. Then they rated the app in 5 categories. Feelings of connectedness, decreased feelings of social isolation, feelings of encouragement, feelings of hope, and feelings of positivity were all highly rated after engaging with the app. In addition, females reported significantly higher ratings of social connectedness after engaging with the app than males ($p<.05$) and younger adolescents reported significantly higher ratings of social connectedness and decreased feelings of social isolation after using the app ($p<.05$).

The Development and Use of the App “Wish List With Friends” or “WLWF” to Increase Feelings of Social Connectedness Amongst Adolescents

Introduction

- March, 2020 → WHO declared COVID-19 as a global pandemic.
- April, 2020 → About ½ of the world’s population in more than 90 countries went into some form of lockdown.
- August, 2020 → CDC announced over 64% out of more than 5,400 young adults reported experiencing social isolation (3 times higher than 2019).
- Walsh, 2021 → 61% of 18-25 year old adolescents reported high levels of loneliness
- Lejuez, R. Hopko & D. Hopko, 2001 → Behavioral Activation Treatment



- Feldmeier, 2020 → Over 90% youth have access to social media



Connecting this to Auxier & Anderson data analysis

Social media can be used as a vehicle to reconnect adolescents during the pandemic.

Methodology

Code the app



Test the app

Participants (13):
31% male students
69% female students

IV: Use of App
DV: Rating of App
CV: age, video exposure, survey questions

SURVEY QUESTIONS:

1. This app will be able to make me feel more connected to friends. *

2. This app will be able to decrease feelings of social isolation. *

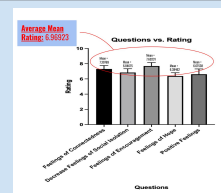
3. This app will be able to encourage me to reach out to friends and family. *

4. This app will be able to make me feel more hopeful. *

5. This app will be able to make me feel more positive about my life. *

Results & Analysis

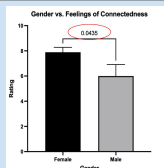
Overall Result



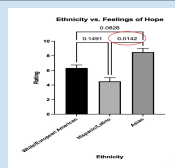
App Rated Highly

- Average Mean Rating: 6.96923
- High Mean Reported Scores
- Low standard deviation showing consistency in ratings

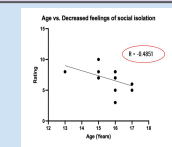
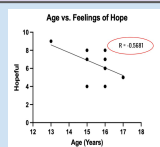
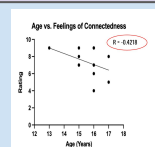
Gender vs. Rating



Ethnicity vs. Rating



Age vs. Rating



Conclusion & Future Research

Hypothesis: If adolescents use the new app, they will report decreased feelings of social isolation and increased feelings of social connectedness with friends and family after using the app.

- Hypothesis supported: New app ↓ feelings of social isolation & ↑ feelings of social connectedness in all demographics
- Females reported significantly higher ratings of social connectedness after using the app compared to males
- Younger adolescents reported that they were more likely to feel connected, hopeful and decreased feelings of social isolation
- WLWF = Effective Behavioral Activation Treatment

Future Research:

- Live app needs to be tested by focus groups to determine unforeseen negative uses
- Evaluate app through focus groups
- Participants with various demographic groups

Keelan Vaswani

Patterns in Cognitive Distortions Among High School Students: An Analysis of How Achievement and Social Situations Influence Types of Thinking

**Location of Research:**

Harrison High School

Mentor:

Dr. Roger Covin

Will be Attending:

University of California Davis

Intended Major:

Cognitive Psychology

Fairs & Awards:

Regeneron STS 2022 - Top 300 Scholar
WESEF 2022: Honorable Mention Award
HHS Symposium 2022, 2021, 2020

Cognitive distortions are individually generated thoughts or feelings that are negative, persuasive, and usually inaccurately based in reality. Types of negative self-talk can be connected to stress and anxiety development in students. The purpose of this study was: 1. To determine which cognitive distortions affect high school students more frequently in achievement and social situations and whether it mirrors the college students found by Covin (2011). 2. To examine whether the students who reported higher GPAs and engaged in more rigorous academic courses reported higher frequencies of cognitive distortions. 43 high school students, aged 14-17, participated in the study. Students completed a survey that collected demographics and assessed frequency that they experienced cognitive distortions in achievement and social situations using a scale adapted by Dr. Roger Covin (2011). Major findings included that similar patterns in cognitive distortions were found in high school students as the college students in Covin (2011). Students were more likely to engage in catastrophizing and should statements in achievement situations ($p < .05$), and mind reading in social situations ($p < .05$). Students with higher GPAs and engagement in more rigorous coursework reported lower frequencies of cognitive distortions in both situations, however the results were not significant ($p > .05$). The similarity in data between these high school students and the college students in Covin (2011), supports that younger and older adolescents experience similar types of negative self-talk. Future research is needed to understand why students who chose less rigorous pathways in high school, experience higher levels of cognitive distortions.

Patterns in Cognitive Distortions Among High School Students: An Analysis of How Achievement and Social Situations Influence Types of Thinking

Introduction

Cognitive Distortions = Types of Thinking

Individually generating thoughts or feelings that are negative, persuasive, and inaccurately based on reality.

Stress and Anxiety: Academic Environments



Gyadz (2015): Grades = Major source of stress
Davidson Institute: High achieving students may feel pressure to be perfect.

Stress and Anxiety: Social Environments



Sigfusdottir et al (2016): Found that peers and family influence feelings of anger, depression, and anxiety for adolescents.

10 Common Cognitive Distortions, Covin(2011)



Methodology

Literature Review

Permission for Scale

Create Survey and Consent Forms

IRB Approval

Recruited Participants

Analyzed Data

Drew Conclusions

Hypotheses

- (1) High School students **will experience similar patterns** of cognitive distortions to **college students**
- (2) **Positive correlation** expected between **GPA** and reported frequency of **cognitive distortions**
- (3) **Positive correlation** expected between **course level** and reported frequency of **cognitive distortions**

Variables

Independent	Dependent	Controlled
- Class Level - Grade Percent Average	Frequency of Cognitive Distortions	- Cognitive Distortion Types - Northeastern United States - Age Range - Public High Schoolers

Types of Thinking Survey

Part 1: Demographic Information

Part 2: Types of Thinking Scale (Covin, 2011)

Results & Analysis

Fig 1.1: Achievement and Social Situations

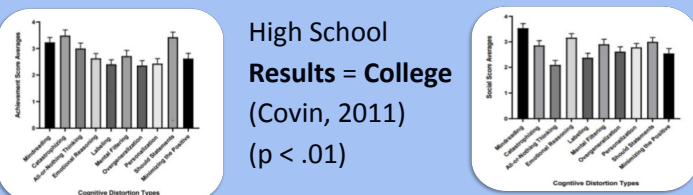


Fig 1.2: Achievement and Social Situations

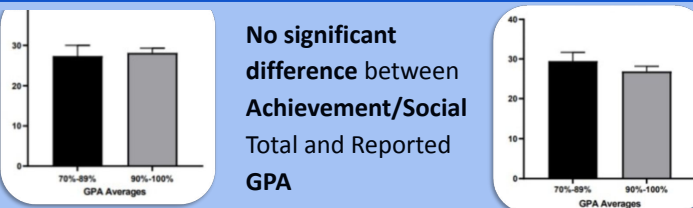
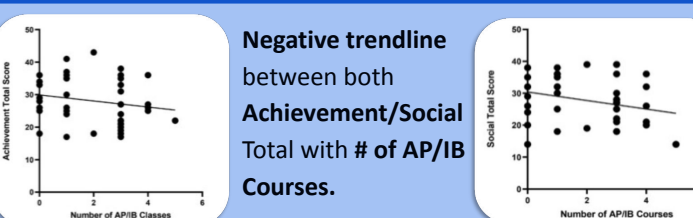


Fig 1.2: Achievement and Social Situations



Conclusion & Future Research

Discussion

- **Hypothesis #1 Supported:** High School Students = College Students (Covin, 2011)
- **Hypothesis #2 Not Supported:** Higher reported GPA \neq Higher Frequency of Cognitive Distortions
- **Higher # of reported AP/IB Courses \neq Higher Frequency of Cognitive Distortions**

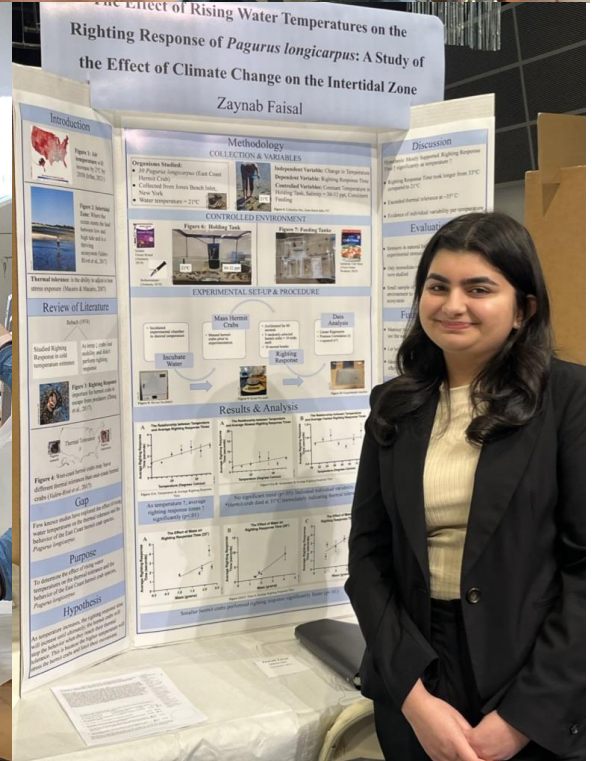
Future Research

- Adolescents of all ages **experience similar negative self-talk**
- **Opportunity Sampling:** Need to diversify sample
- Explore impact of **Ethnicity** and **Cultural** background
- Participants not interviewed (**Covid -19**)

Implications

- **Identifying** Cognitive Distortions at an earlier age
- **Less Rigorous** Academic Path = **More** Reported Cognitive Distortions
- **Increase mental health support** on students who choose **less academically rigorous pathways**

Science Research II



Ariella Blackman

Developing a Model In Situ Resource Utilization System for Oxygen Sustaining Life Support and Launch Cost Reduction for Mars



Class Year: 2023

Mentor:
Morgan Irons

Martian agriculture may be the most cost-effective means to develop a sustainable human life support system on Mars by employing in-situ resource utilization to convert atmospheric CO₂ into O₂. However, launching necessary Earth soil is prohibitively expensive, and Eichler et al. (2021) failed to germinate seeds in MGS-1, the most accurate Martian regolith simulant available. This study determined whether *Phaseolus acutifolius* could grow in ratios of MGS-1 and Earth-based potting soil and which substrate resulted in maximum O₂ while reducing Earth-based launch mass. Plants were grown in incremental substrate ratios, and an original mathematical model was created to estimate the number of plants required to produce enough O₂ to support human life while minimizing total Earth-based soil mass. Plants germinated in 0%, 25%, and 50% MGS-1 ratios. Results suggested that MGS-1 limited plant growth due to its water-retention properties. A significant difference existed between wet biomasses of plants grown in 50% MGS-1 and 0% MGS-1 ($p < .05$), with no such significant difference for the dry biomasses ($p > .05$). Plants in 50% MGS-1 allocated more resources towards obtaining water with significantly more below-ground biomass than the control ($p < .05$). Model calculations demonstrated a trend from 0% to 25% MGS-1: estimated number of required plants increased (867-1003 plants), but amount of Earth-based soil decreased (101kg-87.2kg). This trend potentially holds between 25% and 50% MGS-1 but is unclear because of large amounts of below-ground biomass. Results imply that ideal regolith content is between 50-75% MGS-1 since cost benefits of increasing regolith outweigh any decreased O₂-production efficiency.

Ava Cefaloni

The Effect of Beats Per Minute of a Metronome on Heart Rate and How Pregame Stress is Impacted



Class Year: 2023

Mentor:
Chris Grippio

Stress can impact the performance of athletes by affecting them physiologically and psychologically, and it can lead to nerves during a performance which could increase risk of mistakes and injury. Physiologically, stress can increase heart rate. Stress is correlated to the Autonomic Nervous System which is the interaction between the Sympathetic and the Parasympathetic systems. Stress can be measured by heart rate because if heart rate is significantly changing, the Autonomic Nervous System is working more. The purpose of this study will be to test, in terms of heart rate, to what extent the beats per minute (BPM) of a metronome can reduce stress. The hypothesis is if the beats per minute of the metronome is lower, then heart rate will decrease, and reported stress levels will also decrease. The methodology entails dividing high school aged athletes into four groups, each using headphones to listen to either 0, 30, 60, or 120 BPM for 5 minutes on a metronome. The test will occur 60 minutes before the athlete warms up for their game/event. Before and after listening, the athlete will complete a stress test and measure their heart rate, so that the effect of the metronome on the athlete's stress levels can be recorded. It is expected that the lower the BPM of the metronome, the lower heart rate will be, which will correlate with a decrease in reported stress levels.

Lauren Davidson

The Effect of Copper Sulfate Concentration on Lifespan and Locomotor Ability of Transgenic Alzheimer's Model *Drosophila melanogaster* with the "Arctic" Mutation



Class Year: 2023

Mentor:
Dr. Cale Whitworth

Copper toxicity has been seen to cause gastrointestinal and neurological problems, renal failure, and even death in humans. A transgenic Alzheimer's Disease (AD) model fly was created through the crossing of a GAL-4 *Drosophila melanogaster* strain and a strain expressing the human "Arctic" AD mutation to most accurately understand how copper exposure could impact AD in humans. The purpose of this study was to determine the effect of various concentrations of Copper Sulfate on Alzheimer's Disease (AD) model *Drosophila melanogaster*. It is expected that as the concentration of copper sulfate increases, there will be a decrease in the lifespan of the flies as well as a decrease in performance in the negative geotaxis assay. Due to the genotypes of the Arctic model progeny being indistinguishable, future research entails utilizing a *Drosophila* ortholog that will be used to test multiple generations to determine if the maximum impactful dose of copper sulfate on the parent will have a generational effect on the F₁ and F₂ generations when they are not exposed to the substance.

Zaynab Faisal

The Effect of Rising Water Temperatures on the Righting Response of *Pagurus longicarpus*: A Study of the Effect of Climate Change on the Intertidal Zone



Class Year: 2023

Mentor:
Dr. Jan Pechenik

Pagurus longicarpus, common hermit crabs living in the intertidal zone on the East Coast of the US, are invertebrates that are incapable of regulating their own body temperatures. The intertidal zone is the location where the ocean meets the land between low and high tide and is a thriving ecosystem. Due to global warming, more days per year reach extreme temperatures which affect organisms in the intertidal zone because tides and the shallowness of water causes it to heat up quickly. Few known studies have explored the effects of rising water temperatures on the thermal tolerance and the behavior of *Pagurus longicarpus*. Experiments were conducted on 30 hermit crabs to determine the temperature they could no longer perform the righting response, when hermit crabs in their shells are flipped over and have to right themselves back up. This behavior is important for them to escape from predators. The hypothesis was that as temperature increases, the righting response time will increase until ultimately, the hermit crabs will stop the behavior when they reach their thermal tolerance. This is because the higher temperature will stress the hermit crabs and limit their movement. The results showed a significant increase in the amount of time it took the hermit crabs to perform the righting response at 33°C compared to the control temperature of 21°C ($p < .01$); the crab tested at 35°C died indicating the maximum range of its thermal tolerance. However, further studies should be conducted because a low r^2 indicated variation between individual hermit crabs.

Ella Farago

Using Virtual Reality as an Agent of Behavioral Change



Class Year: 2023

Virtual Reality can be a way for psychological evaluation that uses digital layering technology to immerse someone into an artificial environment. Therapists and medical professionals in the psychology field have studied virtual reality usage for many phobias and behavioral disorders. Virtual reality is considered an effective and safe way to help an individual overcome unhealthy habits. In addition, the novelty of virtual reality makes it appealing for younger age groups. The purpose of this research will be to explore the efficacy of virtual reality as an intervention to promote behavioral change. Specifically, this study aims to evaluate whether virtual reality could be used to stimulate healthy hand washing habits in a general adolescent population. The hypothesis will be that virtual reality will induce an immediate improvement in hygienic practices, and increase the desire to practice more hygienic practices in high school students. The methodology will entail the surveying of participants to assess their hygienic habits before and after watching a video about germs. One group would watch the video in virtual reality, while the other will watch it on a smartboard. Furthermore, the participants will wash their hands before and after the videos and soap usage will be measured. It is expected that the virtual reality group will show a difference in awareness to hygienic practices in survey responses, and use more soap by the end of the study.

Nicole Giandomenico

A Gene Candidate Approach to Identify if HCSDE1 is Associated with Autism and Motor Delay



Class Year: 2023

Mentor:
Dr. Cale Whitworth

According to the US Center for Disease Control (2020), for every fifty-four children diagnosed with Autism Spectrum Disorder (ASD), a developmental disorder, one in six of those children will also experience motor delays. The purpose of this experiment was to determine if *Drosophila melanogaster* could serve as a valid model organism to research ASD and motor delay by defining novel genes linked to both ASD and motor delay. The gene CSDE1 was identified as a possible candidate for motor delays in autism patients and used in the study because the human gene and the fly ortholog Unr had the best forward and reverse scores in Flybase. The methodology entailed two parts: 1. A gene candidate approach to identify if the fly stocks had motor delays. 2. A genetic cross to rescue the motor delay identified in part 1 through overexpression of human CSDE1. The negative geotaxis assay was used to assess whether motor delay was present in *Drosophila*. The results showed that the hypothesis was supported and the fly ortholog with the Unr mutation performed significantly worse ($p < .05$) than the wild type control meaning that *Drosophila melanogaster* could serve as a valid model for autism and motor delays.

Haku Iijima

To Use Artificial Intelligence to Further Develop Global Positioning Systems to Find the Optimal Path to a Moving Target



Artificial Intelligence is used in numerous recent technologies to further improve everyday conveniences. Unsupervised AI could be used to create a self-developing GPS system that would accurately find the optimal path to get to a place. The purpose of this experiment is to improve GPS systems so that they can path a moving target. The hypothesis states, although it may take time for the AI to improve and become usable, it will eventually reach that threshold. Since the AI is trying to determine a path to a moving object, it cannot just learn one optimal path, but learn to adapt which may take more time. The algorithm will be tested by making a small "map" for this AI to run in. Initially the AI will be running against stationary targets to see its accuracy, then see if it will be able to be used on moving targets, then more larger maps. It is expected that the AI will not be the optimal solution to this topic, but will be a valid way to attempt it. It may take thousands of trials before the AI is complete since it is improving off of changing targets.

Class Year: 2023

Andre Joubert

The Evaluation of the Knowledge of Youth about the Interconnectedness of Humans & the Natural World in the US and South Africa as a Baseline Metric for Future Policy Decisions



During COVID19, many people living close to the poverty line suffered. Instead of focusing on conservation and biodiversity, governments relocated funds away from conservation to economic relief. As ecosystems are exploited, animals that often thrive are those that carry zoonotic diseases like Coronavirus. Decreased focus on biodiversity and conservation could result in more severe pandemics. This study determined whether youth in South Africa (SA) or the US, the political and environmental leaders of the future, understood the interconnectedness between humans and their environment. The US and SA were chosen because both are biodiversity-rich countries. It was hypothesized that the critical role conservation plays in the socio-economic and cultural landscape in SA would cause students to report increased awareness. High School students in the US and SA were surveyed. The survey consisted of three categories: Abuse of Nature; Benefits of Protected and Conserved Areas; and Interconnectedness of Humans, Animals, & the Environment. Students rated their level of understanding on a Likert scale from 1(I disagree) to 5(I agree). Results showed no significant differences in average total scores ($p > .05$) or in any average total category scores ($p > .05$) indicating that the average level of understanding was similar between the US and SA. However, the percentage of students who reported "no opinion" was significantly greater for Abuse of Nature in SA than in the US ($p < .05$), and significantly fewer students in SA reported that they were more aware of abuses of nature indicating that US students may be more informed on this topic.

Class Year: 2023

Mentor:
Dr. Magda Goosen

Rachel Kindler

A New York State Life Cycle Inventory of Plant Based Milks Compared to Cow's Milk in Terms of Environmental Sustainability, Nutrition, and Cost



Class Year: 2023

Mentor:
Dr. Julian Silverman

The US Food and Drug Administration defines milk as, “the lacteal secretion, practically free from colostrum, obtained by the complete milking of one or more healthy cows.” Recently, however, there has been a rise in popularity of plant based milk products because there is an impression that they are healthier to consume and more sustainable for the environment even though they technically aren’t milks. Confusion exists as to whether plant based milks are in fact more nutritious and more environmentally sustainable. A life cycle assessment is a methodology in which inputs and outputs for a specific process are assessed to determine sustainability with quantifiable outcomes. A life cycle inventory is a part of a life cycle assessment that focuses on the sustainability of a product from extraction of the raw materials to arrival at the store. The purpose of this study is to conduct a life cycle inventory to determine which milk is optimal for New York residents in terms of environmental sustainability (greenhouse gas emissions), nutrition (protein concentration), and cost. It is hypothesized that, surprisingly, the difference in environmental sustainability between plant-based milks and cow’s milk will not be significant, as the raw ingredients for the plant-based milks are mainly grown in one state and then transported across the country, whereas cow’s milk is sourced directly in New York. In addition, cow’s milk will be more nutrient dense in terms of protein per liter.

Elena McCann

The Effect of Ethanol on the Regeneration of *Lumbriculus variegatus* in Relation to Fetal Alcohol Syndrome



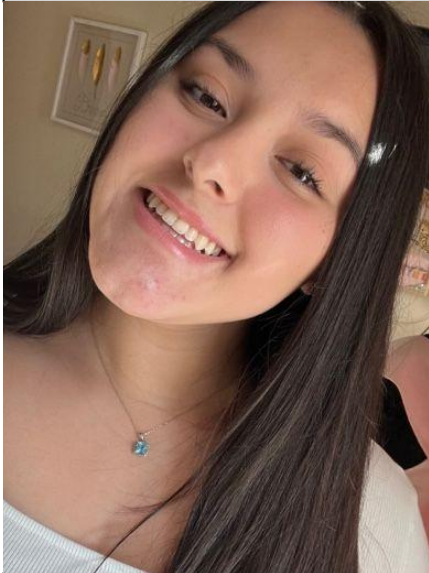
Class Year: 2023

Mentor:
Dr. Daniel Shain

Fetal Alcohol Syndrome is a disorder that affects a child's mental and physical development caused by alcohol consumption from a mother during pregnancy. *Lumbriculus variegatus* (the California Black Worm) is an ideal model organism for studying development because it regenerates tissue at a fast pace. A dose response study was conducted to determine the phenotypic changes in regenerative tissue of *Lumbriculus variegatus* when exposed to various concentrations of ethanol (EtOH). The methodology consisted of soaking the severed head and tail ends of 35 worms (5 per concentration) in 7 concentrations of EtOH (0.00%, 0.01%, 0.10%, 0.50%, 1.00%, 5.00%, 10.00%). Thus, measuring survival probability and cumulative regenerative growth over a 16 day period. Kaplan Meier curves showed that the greater the concentration of EtOH, the shorter the survival probability of both the head and tail ends of the worms. In addition, the slopes of the experimental groups in the cumulative review of regenerative tissue growth were significantly different then the control ($p < 0.01$). This demonstrates that *Lumbriculus variegatus* is a successful model organism to study effects of FAS. This information can be used to further study which specific genes are affected when various concentrations of EtOH come in contact with regenerative tissue.

Leslie Rubio

The Effect of Chemotherapy on Pediatric Cancer Patients Cognitive Domain of Processing Speed Post Treatment



Class Year: 2023

Mentor:
Dr. Suzanne Braniecki

Cognitive processing speed is something that all of us depend on to complete mental tasks such as comprehending and reacting to information. Chemotherapy is a treatment most commonly used to battle and kill fast-growing cancer cells. Even though Chemotherapy can be necessary for the survival of some pediatric cancer patients, it is unclear whether there are lasting cognitive effects. Aziz (2007) found that survivors experience difficulties with working memory and processing information. Furthermore, Erdman (2017) found a negative correlation between chemotherapy treatment and a survivors' performance on n-back performance tests and processing speed setbacks. The purpose of this study is to determine to what extent chemotherapy has affected the survivor's domain of processing speed. It is hypothesized that post chemotherapy processing speed will be diminished compared to their peers who have not had chemotherapy treatment. The methodology includes at least two neuropsychological cognitive screener tests. One group has had tests administered before and after chemo. and other participants were tested twice after chemotherapy with some time interval in between the testing. The cognitive tests that were administered were the grooved pegboard test, symbol search test, and a coding test. Post testing cancer survivorship protocols will be used to analyze and calculate scaled scores (Ss) from raw/ standard scores (ss). Based on the hypothesis it is expected that pediatric cancer survivors will have a decline in their processing speed post chemotherapy. Future research will be directed to determine if chemotherapy affects males and females processing speed differently.

Lauren Schnapp

Strengthening the Idea that *Drosophila melanogaster* is a Good Model Organism for Studying Narcolepsy



Class Year: 2023

Mentor:
Dr. Cale Whitworth

Type 1 Narcolepsy is a chronic sleep disorder characterized by sleep disruption, overwhelming daytime drowsiness, and sudden attacks of sleep. This type includes Cataplexy which results in a sudden loss of muscle tone leading to weakness and a loss of voluntary muscle control, and increased irritability and aggressive behaviors. Hypocretin is a brain chemical that regulates wakefulness. People with Type 1 narcolepsy (narcolepsy with cataplexy) are hypocretin deficient. *Drosophila melanogaster* can be a good model organism because they share 75 similar genes to humans and they have short lifespans and reproduce quickly. *Drosophila* does not have hypocretin but does have Pigment Dispersing Factor (PDF). It has been suggested that PDF may play a similar role in *Drosophila* as hypocretin does in humans. The purpose of this study is to determine if sleep patterns and behaviors associated with narcolepsy in humans present similarly in *Drosophila melanogaster*. The hypothesis is that mutant *Drosophila melanogaster* for PDF will be a good model organism for narcolepsy in humans because they will demonstrate abnormal sleep patterns, motor deficiencies, and aggressive behaviors which can be symptoms of narcolepsy in humans. The methodology entails 3 parts: 1) A *Drosophila* Activity Monitoring System will be used to determine *Drosophila* sleep patterns, they are declared asleep if there is no movement for 5+ minutes. 2) The Negative Geotaxis Assay will be used to determine if the flies are experiencing cataplexy because their performance will be delayed. 3) Aggressive behaviors such as butting of heads and wing flicking will be tracked. It is expected that *Drosophila melanogaster* will be a good model organism for narcolepsy because PDF mutant flies will experience interrupted sleep patterns, have a delayed response to the negative geotaxis assay, and will show behavioral differences and signs of aggression when compared to wild type flies.

Hayanna Silva

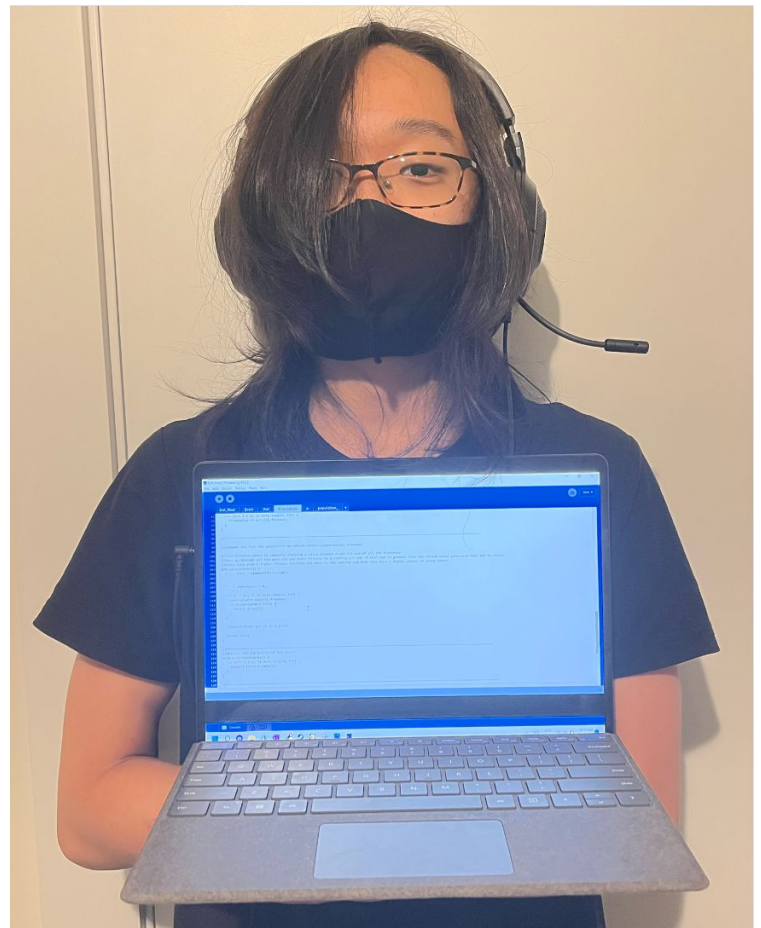
The Effect of Cholesterol Starvation on Tumor Development



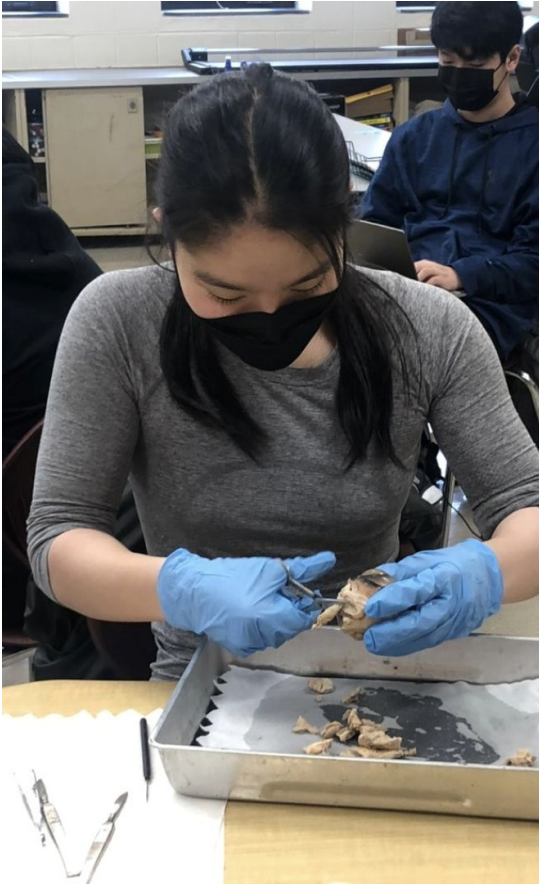
Class Year: 2023

Mentor:
Dr. Cale Whitworth

Lymphoma is a variety of cancer that originates in lymphocytes or histiocytes. There are multiple different types of Lymphoma but they are categorized into two broad groups. Hodgkin's Lymphoma is characterized by the presence of Reed-Sternberg cells. Non Hodgkin's Lymphoma is characterized by the presence of cancerous lymphocytes of the lymph nodes. Cholesterol is an essential component of cell membranes that influences the permeability and fluidity of the lipid bilayer as well as contributing to cell-cell signaling pathways. Healthy cells can either synthesize cholesterol or take it up from lipoproteins to meet their metabolic needs. Malignant cells need cholesterol uptake from lipoproteins to survive. Recent data suggest Lymphoma cells are dependent on lipoprotein mediated cholesterol uptake. Unlike vertebrates, insects are cholesterol auxotrophs that are unable to synthesize this essential compound. The purpose of this experiment will be to explore whether cholesterol starvation will affect the formation of cancerous overgrowths in the eyes of *Drosophila melanogaster* that contain the UAS-yki.S168A mutation. It is hypothesized that *Drosophila melanogaster* that contains the UAS-yki.S168A mutation when deprived of cholesterol will show a decrease of tumors and/or tumor development. The experimental approach taken will involve looking at mutation in the fly eye. The formation of many organs in *Drosophila*, including the eye, is controlled by the same genes that control organ development in vertebrates. *Drosophila* eyes are relatively big and are very amenable to genetic manipulations and scoring resulting phenotypes. The fly eyes are home to some of the most foundational discoveries in cancer biology and are thus a validated model for cancers.



Science Research I



Galle Blaustein

The Effect of Melatonin in the Viability of the IGF-1R Signaling Pathway in Triple Negative Breast Cancer

Newer studies propose that melatonin may be an effective therapeutic mechanism to prevent the progression of breast cancer. Melatonin, a hormone secreted by pineal gland, exerts antimetastatic effects by reducing tumor cell proliferation, migration and invasion. Mota (2018) concluded that melatonin was able to enhance the expression of mir-152 in a MDA-MB-468 cell line in vivo and vitro but did not modulate it in the MDA-MB-231 cell line, demonstrating that the miRNAs can be regulated in different ways in different genetic expressions. MiRNA codes are small, non-coding RNAs that play a crucial role in regulation of gene expression and biological processes of the cells. Among MiRNAs, the miR-152 demands special interest, because its decrease has been associated with the process of cell proliferation, invasion and angiogenesis in different neoplasms such as breast neoplasm. This MiRNA can act on the pathway of angiogenesis, targeting IGF-1R and IRS1, which leads to the inhibition of some signaling pathways in the cell, culminating in the inhibition of HIF-1 α and VEGF, factors that promote the synthesis of new blood vessels, whereas the activation of the IGF-1R signaling pathway promotes the proliferation, survival, and metastasis of breast cancer cells. When this receptor is blocked, it may also block the expression of HIF-1 α and VEGF. As Mota (2018), was not able to develop a study on the modulation of melatonin in IGF-1R in angiogenesis, it is key to understanding melatonin's effects on the different genes suppressed with MiRNAs in the body. The purpose of this study will be to use different concentrations of Melatonin in mir-152 expressions in IGF-1R pathways in triple negative breast cancer to try to suppress the survival of the circular pathway using a vivo and vitro study.

Adelaide Boyle

The Relationship Between a History of Starvation and Aggressive Behaviors in Rescue Dogs

Each year, the American Society for the Prevention of Cruelty to Animals (ASPCA) receives hundreds of dogs from criminal cruelty cases, abandonment, and hoarding homes. Many of these future pets arrive at the ASPCA vastly underweight. It is unclear how a history of starvation in a newly rescued dog can lead to aggressive behaviors towards either their owners or towards other dogs. The purpose of this study will be to create an algorithm to predict aggressive behaviors in rescue dogs based on their weight at rescue, teeth condition, and observation of their daily lifestyle. Teeth can provide clues about a dog's diet as gums should be pink with no redness and the teeth should be white. It is expected that underweight shelter dogs will be more aggressive towards humans and have a more difficult time adapting to a new family home. Future research will further investigate whether breed and sex of the rescue dogs have an effect on aggressive tendencies.

Julia Carrea

Using Eye-Tracking Technology to Detect Emotion

Parkinson's Disease is a neurodegenerative disease that leads to difficulty in communication, including the slurring of words, mumbling, tremors, and trouble with pronunciation. In addition, due to a lack of facial expression, it is difficult for Parkinson's patients to express emotion. Eye-tracking is a revolutionary technology that tracks movements of the eye through the use of invisible infrared light and camera sensors and may have the ability to express feelings, especially empathy, that Parkinson's patients may not be able to demonstrate in more conventional ways. Fixations occur when the eye stops to collect visual data, possibly signifying the strength of an emotion. In a study done by Alfonso Pico, Raul Espert, and Marien Gadea, a significantly greater number of fixations was found when participants were exposed to faces with tears as opposed to those without, indicating that more information was processed. In addition, faces with tears also brought out a greater level of empathy, found through the use of an empathy test called, RMET (Reading the Mind in the Eyes). The purpose of this study will be to construct and utilize an eye-tracking device in order to determine connections between eye fixations and empathy levels. Because of accessibility, high school students will be tested. It can be hypothesized that more empathy will be demonstrated when exposed to faces with tears as opposed to faces with freckles, pimples, or none of the above, as tears signify a stronger emotion, allowing them to attract the eye more readily, leading to increased fixations.

Mia Castillo

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

Earth's surface is 70% of water, only 1.2% of that water is obtainable and drinkable. Water scarcity is a huge problem earth will face in years to come so we must turn to alternative ways to get clean water. Distillation is the process of boiling liquids to separate them from salt and contaminants. Distilling water takes lots of time and energy; standard distilling methods can be harmful to the environment and are very expensive. Some scientists have turned to solar distillation to reduce the cost. However, solar panels are not always efficient and waste that accumulates during the evaporation process could block the solar panels, further impacting the production rate. Surface area plays a vital part in distilling water because more surface area results in higher distillation rates. Wu (2020) 3D printed a cone/'bird beak' shaped solar evaporator structure to maximize the amount of water distilled. They came up with this 3D shape by choice; they did not test which shape would best suit the distillation apparatus. The purpose of this study will be to test different 3D shapes and to study which one has the highest clean water production rate. Determining a proper disposal unit for the precipitate will also be considered when designing the solar evaporator apparatus.

Anthony Cipriano

The Effect of Beet Juice Supplementation on Exercise Tolerance During Intense Sports Training in High School Athletes

Since the 1950s, some pro athletes have resorted to the use of illegal supplements to enhance their performance. However, these supplements have severe side effects and, if players are caught using them, can result in players being suspended from play. Natural supplements are products made by plants that can be used to treat diseases and enhance health. Beet juice may be an effective natural supplement because it contains nitric oxide which functions in vasodilation. Vasodilation is the process of widening blood vessels which allows for an increase in blood flow and oxygen flow. This is important when engaging in sports because if oxygen flow is increased, more energy can be produced. Bailey et al. (2009) found that Beet Juice was able to significantly decrease oxygen cost during extreme exercise in young adult men. However, they did not experimentally determine whether increased intake of dietary nitrate can enhance exercise tolerance during long-term endurance training. Therefore, the purpose of this study will be to examine if beet juice supplementation can improve exercise tolerance during intense sports training in high school athletes.

Sofia Coimbra

The Effect of Different Colored Lighting on the Ability to Retain Information

Memory can be defined as the brain's capability to retain and store information. The electromagnetic spectrum consists of colors existing on different energy levels, depositing frequencies into our surrounding environment. Color theory is the study of how colors translate into human emotions, and how people react to and interpret such colors. It was found that color has the potential to increase the chances of external stimuli being successfully stored in the brain. (Dzulkifli, 2013). The effect of certain colored surroundings on heart rate has been studied, the heart rate increasing with red and yellow hues and decreasing with blue hues. (AL-Ayash, 2015). However, few known studies have directly evaluated the effect color has on memory and the ability to retain information. The purpose of this study will be to find a correlation between different colored lighting and how it affects memory, seeing as there is an existing physiological and psychological impact of color. By finding the connection between colored lighting and memory, this research will hopefully be applicable in work, school, and social environments to enhance people's ability to retain information.

Mason Danzig

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

Holocaust Education is an important step in ensuring that history isn't repeated. Holocaust education has been shown to not only improve knowledge, but it also increase empathy and one's willingness to be an upstander and stand up for what's morally correct in difficult situations. While the Holocaust is a very widely known and taught subject in schools throughout the world, there are many problems around teaching it. Since it is a very gruesome and tragic event in history, if it is taught wrong through the use of graphic photos or popular movies that are too vague, or too early with young kids it can have a negative effect on the student and their perception of the Holocaust and can even lead to PTSD. Learning about the Holocaust through Holocaust Survivors is the most effective method, but the number of Holocaust survivors is dwindling steadily. Linda Medvin, a leader of the Florida Department of Education Commissioner's Task Force on Holocaust Education, found that students exposed to Holocaust education demonstrate higher critical thinking skills and a greater sense of social responsibility as well as being more open-minded to different viewpoints including race and sexual orientation. One way at testing the effect of Holocaust education is to test empathy using the Interpersonal Reactivity Index as developed by Davis. This scale measures dispositional empathy through the use of four major categories: fantasy, perspective taking, empathic concerns and personal distress. However, no evidence tests the most effective method of Holocaust Education that leaves the audience with the greatest dispositional empathy. Future research will test this through surveys done on high school students whether text, videos or holograms are the most effective method for keeping these stories alive for generations to come.

Alexia De La Jara Cabero

Determining How Implicit Biases Are Reinforced in Social Media Platforms Such as TikTok

Implicit bias refers to views or preconceptions that influence our understanding, behaviors, and decisions without our knowledge. The social media portrayal of outgroup members is commonly regarded to have an impact on bias and stereotyping among the general population. Outgroups are defined as consisting of people who do not belong to one's own social group. Ingroups represent people who are part of an individual's social group. With more than 500 million users, TikTok's large audience makes it a valuable source of information for ingroup members' impressions of other social groupings. Despite this widespread use, the research on the possible effects of social media on bias, particularly image-based platforms, remains unknown. The purpose of this study is to determine how implicit biases are reinforced in social media platforms such as TikTok. In particular, outgroup views will be examined. The methodology will consist of creating a codebook to identify stereotypes associated with different groups of people. Then, high school students will be asked to use the code book to determine the number of times that stereotypes of people in their outgroup appear on their feeds.

Isabella Estroff-Liberti

The Effect of Socioeconomic Status on the Rate of Domestic Violence

Domestic violence is aggressive behavior towards a spouse or partner to assert control and dominance. According to the Domestic violence hotline, 25% of girls experience an incident's of domestic violence before the age of 18 and 20% of all women are abused at some point in their marriage. The purpose of this study will be to determine if a correlation exists between socioeconomic status and domestic violence rates within a suburban county in New State. It is hypothesized that the higher the socioeconomic wealth and the greater the desire to protect one's reputation will result in more incidences of domestic violence. In addition, more wealth may correlate with one partner having more power in a relationship making it difficult for a victim to leave the relationship. The methodology involves conducting a systematic observation of police beats in different towns for visible signs of disrepair including graffiti, litter, broken windows and physical decay. Multiple observers will rank whether these signs of disrepair are present on a scale of 1-5. Zillow will also be consulted to determine average house prices in an area. Second, police FOIL reports will be collected for incidences of domestic violence for each town in the years 2000-2022. It is expected that higher socioeconomic statuses will correlate with higher rates of domestic violence; although, it is possible that powerful people may be able to cover up disreputable behaviors given their status in society which could cause fewer cases to be reported than are actually happening. Further research will involve determining how many domestic violence cases happen but go unreported.

Benjamin Gold

Using Bioinformatics to Analyze the Correlation Between the Human Microbiome and Brain Disease

The human microbiome is very important to how the human body works, although there is some mystery around it within the scientific community. The microbiome is a symbiotic relationship in the human body with many different species of fungi, bacteria, and other microorganisms. It helps with digestion, but also is believed to connect to the immune system, brain, lungs, and other organ systems. It is also known to be affected by chemicals, such as SVOCs (semivolatile organic compounds, commonly found in electronic appliances), and can have the diversity of its species reduced. Scientists are trying to look into how the microbiome correlates to disease in parts of the body, such as Parkinson's or lung cancer. One way that this is being done is through bioinformatics, which is a form of research that is based around using specialized computer software to analyze sets of biological data that have been anonymously collected from various patients. The purpose of this study will be to analyze whether or not patterns exist between the makeup of the gut microbiome in patients with brain diseases such as Parkinson's. Specifically, this study aims to look at potential trends in microbial makeup, such as levels of diversity or specific species of bacteria/fungi being present, that are more likely to appear in patients of Parkinson's disease.

Kento Honda

Using ArcGIS Satellite Images to Investigate the Effects of Artificial Snow on Plant Life

Artificial snow is snow made by people during ski season so that tourists can ski throughout the winter months without interruption. Artificial snow has a different chemical composition than natural snow because it is collected from reservoirs, lakes and springs. In addition, ice nucleating agents, bacteria that promote the formation of ice crystals are present on leaf surfaces, increasing the threshold temperature at which water freezes, damaging plant cells. The purpose of this study will be to investigate the differences in the effects of natural and artificial snow, which covers about 30% of the ground surface in winter, on plants. The hypothesis will be that in ski resorts with a lot of artificial snow, more damage will be observed in plants than in resorts that rely almost exclusively on natural snow because the extra water and snow nucleating agents in artificial snow will damage plants. Using ArcGIS, satellite images will be used to compare the change in vegetation around ski resorts where artificial snow is used more frequently with the change in vegetation in similar climates where only natural snow falls. The expected result will be that the vegetation around ski resorts where a lot of artificial snow is used will be damaged so that every year there will be clearly less greenery around the ski resort after the snow melts.

Blayse Jennings

Examining the Extent to which Social Media Inadvertently Reinforces Sadness & Depression

Social media has given teenagers an outlet to talk about the way they feel, and the things that they are going through whether the experiences are positive or negative. Over time, as social media platforms continue to grow more people join and seek comfort in others. However, many are unaware that there are dangers associated with social media use. For example, teenagers may freely express their opinion about mental health issues without knowing the effects that it could cause on the person behind the screen. The purpose of this study will be to examine the extent to which social media inadvertently reinforces sadness and depression by quantifying the intensity of negative experiences on TikTok. It is hypothesized that TikTok hashtags that represent feelings of loneliness, sadness and depression will be liked more than hashtags that represent feelings of happiness and positivity. In addition, because social media transforms the way that people interact, adolescents are more likely to share negative feelings in comments and feel validated in those negative feelings which could translate into unhealthy behaviors.

Colin Maddaloni

How Warming Sea Temperatures Affects Fish Populations in the Long Island Sound

The Long Island Sound is an estuary of the Atlantic Ocean and is home to 52+ bird species, 100+ fish species, and many types of crustaceans and shellfish. The Long Island Sound faces many challenges with maintaining the populations of fish. Climate Change has been one of the more predominant issues for fish. The Long Island Sound surface and bottom temperature has risen 2.8°F per decade since 1977. The purpose of this study is to determine which new fish species are being introduced to the Long Island Sound because of the warming sea water temperatures. It is hypothesized that fish such as blue runners which are normally native to Florida will be present. The methodology will consist of counting and recording the number and type of fish caught on a 32 foot downeast fishing boat located in New Rochelle, New York, throughout June, July and August, 2022. Future research will determine how the presence of these new species will affect the ecosystems of the Long Island Sound.

Michael Mainland

Using Global Flexibility as a Means of Relieving Text Neck: A Comparison Between Local and Global Flexibility

Text neck is a stress injury in the neck that is caused by having your head in a forward position for an extended period of time usually associated with texting or use of other technological devices. Flexibility is localized and compartmentalized to one muscle or group of muscles. Agility or global flexibility is flexibility in motion and is systemic in nature. Many fitness professionals and athletes believe that static or structural stretching increases flexibility, prevents injury, and improves performance. Recently it has been found that global flexibility, individual motions which make up body movements, have a larger effect. The purpose of this study will be to determine if global exercises aimed at relieving stress in the thoracic spine and neck will decrease reports of pain and increase the range of motion in the neck and spine when compared to structural and individual neck exercises. It is hypothesized that global exercises will be more effective because they reinforce the body's innate movements by being systemic in nature.

Magda Mani

The Effect of Microzooplankton on the Biomagnification of *Alexandrium* Toxins

In the Long Island Sound, *Alexandrium fundyense*, a species of toxic phytoplankton that are responsible for harmful algae blooms which prohibit seafloor autotrophs from photosynthesizing, exhaust oxygen from the water, and cause toxins to accumulate in the food web. Scientists have been working to determine the most effective way to prevent these toxic blooms and restore the health of the ecosystem. This study will focus on *Alexandrium's* natural predator, microzooplankton. Because they lack a nervous system and they don't accumulate copious amounts of *Alexandrium* toxin, microzooplankton act as a sink of toxins in the water column. It is hypothesized that if the proportion of the microzooplankton population increases compared to the *Alexandrium* population it will decrease the effect of biomagnification in the food web since they don't accumulate appreciable amounts of toxins. It is also hypothesized that if the population of the microzooplankton is present, then bivalves like clams, mussels, and oysters will have less toxins present in their system. Simple filtration will be used to isolate the microzooplankton and *Alexandrium* from other organisms and then a hemocytometer will be used to count the number of organisms in each population. Toxins in the bivalves will be measured by using liquid chromatographic post-column oxidation (LCPOX). It is expected that if microzooplankton population increases, it will decrease the quantity of *Alexandrium* which therefore will decrease the biomagnification of their toxins in the food chain.

Margaret Martinez

The Impact of Ethnicity & Cultural Values on Obtaining Mental Health Treatment

A person's cultural background and history can influence their day to day lives. There is a possible link between cultural values and receiving treatment for mental health. People of all ages hesitate seeking help whether it's due to their financial status, immigration status, language barriers, fear of oppression, or cultural values. A person must have a good relationship with their mental health provider in order for treatment to work. If not, they are less likely to want to continue treatment for their mental health and could possibly cause a negative view in receiving treatment for mental illnesses. Corona (2016) conducted a research study with 198 Latinx college students and found that people were more comfortable receiving mental health care from a professional of similar ethnicity and who possesses similar cultural values. The purpose of this study will be to discover how a person's ethnic cultural values play a role in receiving treatment for mental health. How parental figures' values and beliefs impact the likelihood and decision to support their child to receive treatment will also be explored.

Caitlin May

The Relationship Between Personality Type and Music Consumption Habits

Personality is a combination of qualities in an individual that expresses their ways of thinking, feeling, and behaving. Personality is increasingly being used as a metric to provide a more personalized experience for users of different technologies. Music is defined as the composition of vocals and/or instrumentals combined in order to create harmony. Where music is more ordered, noise is more random. In an observational study, Ferwerda et al. (2017) showed significant correlations between the personality traits of users and the music genres that they prefer to listen to based on listening histories. However, no known experiment has tested this connection. The purpose of this study will be to determine if personality type affects music consumption habits. It is hypothesized that people who score higher on the extraversion Myers Briggs Scale will rate music genres with higher beats per minute as more enjoyable/holding the most interest for them. The methodology will involve two parts. The first part will collect demographic information along with information about their personal listening history with the use of the participant's Spotify Wrapped. The participant will take the Myers-Briggs Personality test, then, a dose-response study will be conducted where participants will be exposed to different beats-per-minute of a metronome and asked to rate them with the use of a created scale ranging from 1-10 for personal enjoyment/interest. Finally, the beat-per-minute choices will be compared to the participant's consumption choices on their Spotify Wrapped to see if their experimental selections correspond to their listening histories.

Gabriella Miele

The Correlation Between Brainwaves Released Through Meditation and Emotional Regulation & Cognition in Adolescents

Although meditation is an religious practice spanning back over 6,000 years, it has recently gained traction in the self care industry and community as a way to manage our emotions and promote spiritual well being. Lately, different types of meditation such as mindfulness meditation have been used not only in religious settings but in classrooms, the workplace, or at home. The growing popularity of this method for self improvement sparked interest in the scientific community, as scientists wanted to know the science behind this seemingly mythical, pseudoscientific process. Scientists have been trying to find the ways in which the brain and body are affected by meditation and its useful real world applications. Studies have been conducted on the impact of a 5 week mindfulness meditation academic performance of neurotypical and neurodivergent students as well as the impact of brainwave ratios on the academic performance. Conclusions drawn from both studies found that students were increasingly likely to better manage their emotions and improve academic performance and social skills in a school setting. A 2008 study discovered a more equalized theta/beta brainwave ratio resulted in increased academic achievement in students with learning disabilities. However, few studies have identified which brain waves are released through meditation. The purpose of this study will be to identify the brainwaves released through meditation and then to further explore the function of these brainwaves.

Stella O'Connell

The Effect of Location Within the Gastrointestinal Tract on the Concentration of Th17 Inducing Bacteria Which Contribute to Crohn's Disease

Bacteria within the gastrointestinal, or GI tract can contribute to the pathogenesis of disease. Certain bacteria can induce the development of Th17 cells in mice, immune cells which are linked to chronic inflammatory diseases. Few known studies have found if there is a relationship between the location within the GI tract and the development of Th17 cells in mice. Certain types of bacteria (segmented filamentous bacteria) in mice have been linked to the development of Th17 cells, whose inflammatory characteristics are linked to bowel diseases such as Crohn's disease. However, since the GI tract and gut microbiome are so diverse, it is hard to tell exactly which types of bacteria may have enough of an influence on the development of Th17 cells. The purpose of this study will be to determine if the location within the gastrointestinal tract impacts the development of Th17 cells in order to gain a better understanding of how Th17 cells may impact disease pathogenesis. It is hypothesized that the location within the GI tract will influence the concentration of Th17 inducing bacteria, and be potent enough to have an effect on pathogenesis of Crohn's disease, an inflammatory bowel disease that has many known links to the gut microbiome. This methodology entails two separate parts. The first part will test how location within the GI tract will influence the types of bacteria present, through testing the ileum, colon, and duodenojejunal junction. The second part will test if the bacteria found in different locations along the GI tract will impact the development of Th17 cells, and be potent enough to impact Crohn's disease pathogenesis. It is expected that there will be notable differences of bacteria within the various locations of the GI tract that are being tested, and these bacteria will influence the development of Th17 cells. There will be notable differences because throughout the GI tract there are various numbers of bacteria that are colonized in certain areas, but not in others.

Grace Peacock

The Prevalence of Lumbar Spondylosis in a Suburban New York High School Aged Population

Prevalence is the number of people affected by a disease in a population at a given location at a particular snapshot in time and is an important measure in epidemiology. Spondylosis is a disk degenerative disease that affects the lower spine. Spondylosis can gradually get worse with aging due to stresses that the spine undergoes, however, it can also affect young people who have experienced impact injuries. The purpose of this study is to investigate the prevalence of lumbar Spondylosis in patients under the age of 20, both in patients who have presented to a spine surgeon's office and compared to patients who have not presented at the spine surgeon's office. The methodology involves comparing MRIs of the lower lumbar spine between the two patient groups to identify those affected and then finding commonalities among those who present with Spondylosis. Ultimately, an algorithm will be created to predict the chance of developing Spondylosis at an early age based on family history, gender, weight/BMI, and participation in contact sports.

Luke Petruzello

Determining Whether Creatine Loading is an Effective Way to Increase Muscle Mass and Improve Performance in *Drosophila melanogaster*

Creatine is an amino acid stored in skeletal muscle. It's a substance found naturally in your muscle cells. It helps your muscles produce energy during exercise or a sporting event. Creatine increases lean muscle mass, improves muscle strength, and helps muscles recover quicker. It is helpful for athletes because it provides additional energy and a push to compete better and stronger. Many believe that supplemental creatine improves performance during training and in competitions. Creatine Loading is a way to rapidly maximize your muscle stores. When Creatine Loading, an individual ingests a greater amount of creatine for a couple days and then the normal dosage to maximize your muscle stores faster. It is thought that Creatine has a greater effect on males than females because it increases male testosterone while also increasing the amount of creatine in their body while only increasing the amount of creatine in a female body. The purpose of this study is to determine whether creatine loading is an effective way to increase muscle mass and improve performance in *Drosophila melanogaster*. In addition, it will be explored if creatine affects male and female *Drosophila* similarly. It is expected that creatine loading will increase muscle mass and improve performance more than lower daily creatine supplementation dosing strategies.

Filippa Rasmussen

How Tactile Sense Affects Taste Perception and Flavor Rating

The food we choose to eat is a complex behavior and is influenced by many factors. The fact that we live in a world where food is easily attainable by most has led to food not only being chosen by hunger but also by personal taste preferences, cultural influences, emotional reasons, health concerns, societal pressures, convenience, cost, and more. However, plentiful food supplies have led to picky eating, overeating, and associated health problems. In order to change the food choices we make, it is important to not only focus on changing the sensory attributes of the food itself, but also how environmental and cognitive factors can modify and enhance multisensory flavor perception and preference. The interrelationship between our senses of smell, touch, sight, and sound affect our flavor perception as the five senses collaborate with one another. However, the sense of touch has not been as widely studied for its connection to taste perception and flavor rating. Researchers have found that the texture of plates and cutlery can affect taste, and eating with hands can result in a higher degree of self-control with people being more conscious about what and how much they eat. Although the effect of eating with hands has been studied, little research has been done on how being able to touch the food impacts the taste of the food and the overall eating experience. It is expected that eating with hands will increase overall enjoyment and rating of the food because it will allow the connection between touch and taste. Further research will examine the role of touch and texture on the way food is perceived and how to increase the enjoyment of food to lead to healthier eating.

Korbii Reiff

Using *Wallemia mellicola* as a Pioneer Species to Improve Suitability of Mars Global Simulant as a Growth Medium for Agriculture

Sustained Martian colonization will require the establishment of agriculture on Mars, however most plants cannot grow in Martian regolith due to lack of nutrients, low organic materials, and different water retention from Earth soil. Ecological succession on Earth is a process which prepares soil for more extensive plant growth. Pioneer organisms such as fungi are the first to grow in inhospitable soil, their growth breaks up the soil, and their death deposits nutrients and organic matter, improving the quality of the soil. Xerophilic fungi like *Wallemia mellicola* may be particularly well suited for a Martian environment because of their low moisture requirement. The purpose of this study is to evaluate the extent to which ecological succession, using fungi as a pioneer species, can improve Martian regolith simulant for agricultural purposes. The hypothesis is that an ideal substrate ratio of Martian regolith simulant to Earth soil exists that fungi can grow in to improve the water retention, soil aggregate size, organic matter, nitrogen, and carbon content of the regolith simulant. The methodology entails inoculating different ratios of MGS1 and Earth Soil with *Wallemia mellicola* fungal cultures. After two weeks, the substrate ratios will be analyzed for organic matter content, aggregate size distribution, and water retention. It is expected that as the percentage of Martian regolith simulant in the growth medium decreases the growth of *Wallemia mellicola* will increase. Increased growth will likely create larger mycelium systems improving soil aggregate size and water retention, and greater biomass will add more organic matter and nutrients to the soil.

Alissa Remeza

Cherenkov Photon Misidentification as the Source of MiniBooNE Electron Neutrino Excess

The Standard Model of Particle Physics encompasses scientists' understanding of the fundamental makeup of the universe. Neutrinos are weakly-interacting fundamental particles within that model. Neutrino mass contradicts the predictions of the Standard Model, which predicts neutrinos as massless and offers no explanation as to the minimal neutrino mass discovered. Scientists propose the addition of a "sterile neutrino" as a solution; the theoretical particle serves not only as a solution to neutrino mass but as a candidate to dark matter as well. Theoretical heavy sterile neutrinos are significantly more massive than known neutrinos and could provide the latter with mass. Nevertheless, these neutrinos are solely gravitationally-interacting and detectable through neutrino oscillation anomalies. Cherenkov detectors analyzing neutrino interaction data detected a greater than six-sigma excess of electron-neutrino oscillations, indicating an anomaly that suggested potential light sterile neutrinos. Scientists then established the MicroBooNE Collaboration to further analyze neutrino interactions using a more precise Liquid Argon Time-Projection Chamber (LArTPC), which found results contradicting the previous Cherenkov data and no neutrino excess. The MicroBooNE findings discourage the possibility of a light sterile neutrino. Scientists are unaware of the cause of the MiniBooNE excess, predicting photon misidentification as its source. The purpose of this study will be to test the photon hypothesis by directing a photon beam at the Cherenkov and LArTPC detectors to determine whether increased photon interactions would cause increased reported neutrino detection. Increased reported neutrino data would signal photon misidentification as a portion of neutrino detected, thus explaining the excess. Future research aims to confirm the source of the MicroBooNE excess and analyze further MicroBooNE data. Scientists also aim to improve detectors and analysis techniques, with the DUNE detector and testing current convolutional neural networks respectively.

George Roggiero

The Relationship Between Groundhog Burrows and Biodiversity in a Suburban New York Community

As human developments expand into areas that were previously unsettled, it has become more important to understand the relationship between people and the wild animals that live among them. Groundhogs are of particular interest because many consider them to be pests because they burrow, infiltrate, and use up the natural resources of ecosystems. However, what is less known is that groundhog burrows may be important to the health of wildlife ecosystems because when digging these burrows, the groundhogs dig up new and fresh soil from the ground and disperse these nutrients all around the area the burrow was dug. They also aerate the soil which makes it easier for the roots of plants to respire and take in oxygen. Therefore the areas around groundhog burrows may be richer in biodiversity of plant life. In addition, other animals might seek shelter in the burrows which could increase the number and types of animal species living in an area. The purpose of this study will be to monitor the plant and animal wildlife that occupies several groundhog burrows around a suburban high school in Westchester County, New York, to determine the number and variety of species that occupy these burrows. It is hypothesized that the more the groundhogs burrow and the longer they are in an ecosystem, the more the biodiversity would increase. Future research will seek to determine if the proximity to humans increases the depth that the groundhog burrows. The groundhogs might see the humans as potential predators so this might cause them to burrow deeper into the ground to make them feel safer and more secluded from any potential threats.

Mako Suzuki

The Extent to Which Blue Light Filters Mitigate Effects of Differential Computer Interactions on Eyes

As computers become widely used, more people are experiencing various ocular symptoms such as computer vision syndrome or digital eye strain. One controversial topic in the optic field is the correlation between blue light and eye health. Blue light is a color in the visible spectrum with a high energy and short wavelength. Blue light glasses or filters have been marketed with the claims that they would protect the eye from ocular diseases caused by blue light. Leung, Li, and Kee (2017) found evidence that blue light filters can partially filter blue light without degrading visual performance, collecting reports from more than one third wearers who found filters to be effective in improving anti-glare performance and vision for digital screens. However, several ophthalmologists have countered this idea, stating that blue light glasses are unnecessary because eye strain is caused by a lack of blinking while staring at a screen rather than by the blue light. Blinking is important because it helps to maintain eye moisture and avoid the risk for dry eye. Therefore, the purpose of this study will be to investigate whether differential computer interactions contribute to dry eye and whether blue light glasses mitigate the effects. It is expected that the blue light glasses will not improve the blinking rate and mitigate the effects.

Danielle Topper

Evaluating Protein Linkages through Pathway Analysis within the Autophagy Lysosomal Pathway of Alzheimer's Disease

Alzheimer's disease is a neurodegenerative disorder often caused by overaccumulation of proteins in brain cells resulting in dementia symptoms: memory loss, synaptic decline, and worsened motor function. The autophagy lysosomal pathway is a self-digesting mechanism in which lysosomes remove proteins from body cells. Lysosomes are cell organelles responsible for degrading waste material in body cells, so, the dysfunction of lysosomes associated with age is a key factor in Alzheimer's disease and is responsible for the overaccumulation of proteins. The autophagy lysosomal pathway is important to explore to find causes and treatments for Alzheimer's disease and subsequent dementia symptoms. Bahr (2017) conducted a study using mice, who received daily injections of PADK, which resulted in the increase and improvement of enzyme CathepsinB as well as a decrease in the presence of the over-accumulated amyloid beta protein. He concluded that Z-Phe-Ala-diazomethylketone (PADK) acts as a lysosomal modulatory drug used to combat protein accumulation disorders—like Alzheimer's—by enhancing Cathepsin enzymes to clear tau and amyloid beta proteins. However, the correlation between these genes has only been found in model organisms such as mice and *C. elegans* worms. The purpose of this research will be to visually demonstrate and support the linkage between PADK, CathepsinB, amyloid beta, and tau proteins within humans, using bioinformatics pathway analysis. Once the linkage is established, further research could explore the creation of PADK as a treatment drug to combat Alzheimer's disease and dementia symptoms.

Alexandra Wong

The Effect of Comorbidities on Alzheimer's Disease Through Production of Amyloid-Beta Plaques

Alzheimer's disease (AD) is a slowly progressive disease of the brain, and is especially difficult to diagnose as symptoms do not appear until later in life, unless genetically inherited. Hardening of the arteries, atherosclerosis (ATS), has been a factor researched to explore its effects in blocking blood flow to the brain or any other pathology that could further induce AD. Iadecola (2021), concluded that intracranial ATS is an independent driver of cognitive impairment. Other studies regarding the vascular side such as Circle of Willis, a joining area of several arteries at the bottom side of the brain, suggest that hypertension, an accelerator of ATS may promote AD pathology. Since AD does not reveal symptoms until mid-late years in life, the disease tends to present itself simultaneously with other diseases. Although many studies agree that ATS is not a direct cause but an independent driver, inducing precursors to AD like amyloid-Beta would allow the simplification of understanding how AD interacts with other diseases. This field lacks the understanding of the role comorbidities play in the development of a degenerative pathology. The purpose of this study will be to explore the extent of comorbidities' effect on amyloid-Beta plaques. It is expected that a presence of comorbidities will induce amyloid-Beta plaques in ATS, linking the idea that AD is worsened by the effects of age and general comorbidities in a degenerative human body.

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



HARRISON HIGH SCHOOL SCIENCE AND TECHNOLOGY SYMPOSIUM

Special Thanks:

The students and faculty of the Harrison Science Research Program thank you for coming to this year's Science 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 either of us:

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