

A CONSTELLATION OF RESEARCH

10TH ANNUAL KEYSTONE
SYMPOSIUM

SATURDAY, APRIL 29TH, 9:00AM - 5:00PM

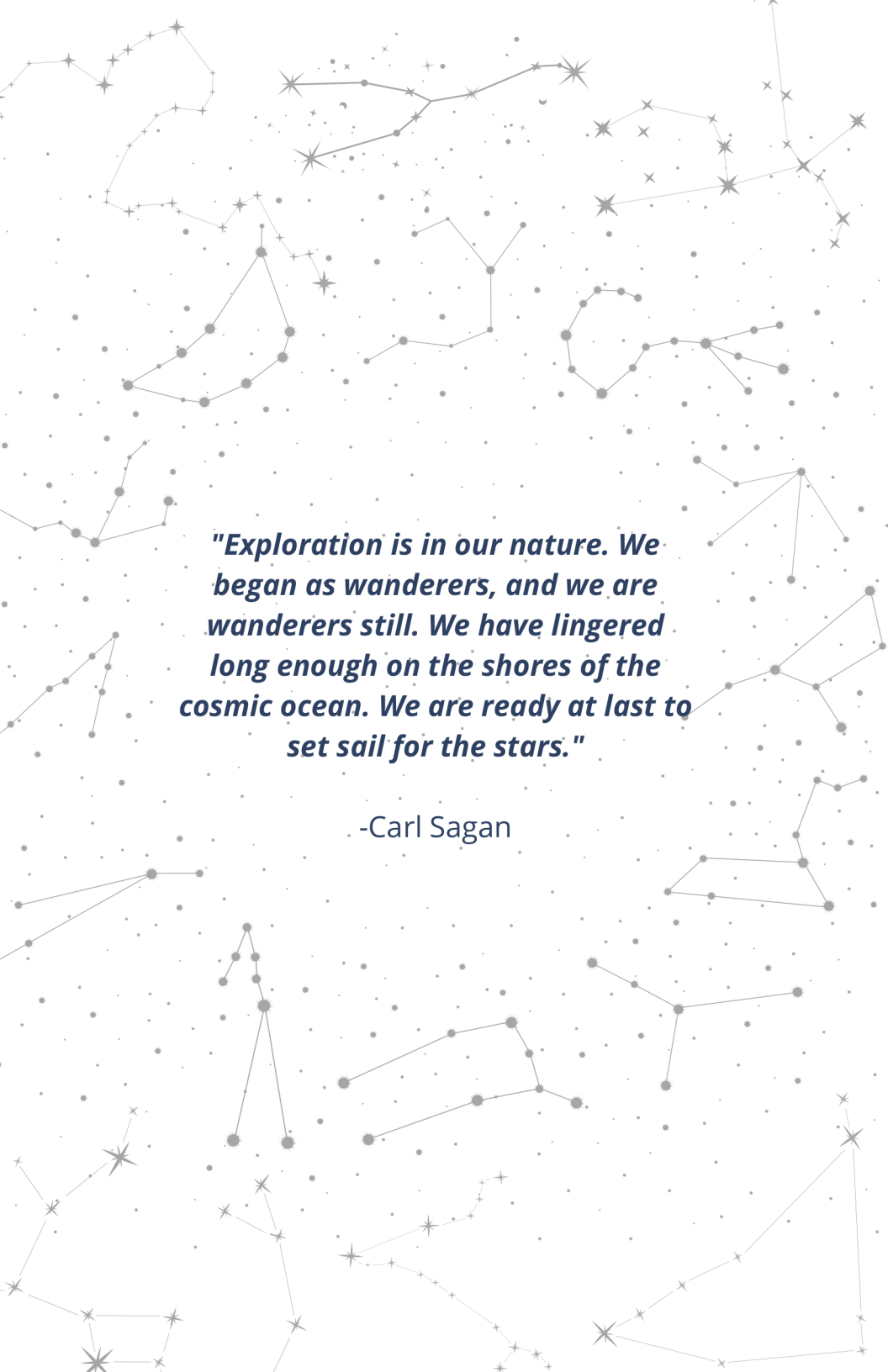
CYGNUS





WELCOME!

**Welcome to the 10th Annual Kilachand
Honors College Keystone Symposium!
We are so excited to illuminate your
day with a constellation of projects.**



"Exploration is in our nature. We began as wanderers, and we are wanderers still. We have lingered long enough on the shores of the cosmic ocean. We are ready at last to set sail for the stars."

-Carl Sagan

MORNING SCHEDULE

9:00

O P E N I N G R E M A R K S

9:15

P O S T E R I N T R O D U C T I O N S

Room 545

Nika Kozlov
Ria Chawla
Max Kroll
Alyssa Goins
Juliana Helfer
Nicole Chiulli
Olivia Lewallen
Sofia Marcelli

Room 613A

Isabel Mullens
Maecey Niksch*
Michelle Roos
Daryna Shnitser
Vikram Srinath
Emily Vu
William Owens
Sophie Li

**Content warning: mentions of domestic violence*

9:40

P O S T E R P R E S E N T A T I O N S & D I S C U S S I O N

- T R A N S I T I O N T O O R A L P R E S E N T A T I O N S -

Time Room 545 Room 613A Room 613B

10:10

P R E S E N T A T I O N I N T R O D U C T I O N S

10:15

Rutva Bhatt

Aiden Cliff

Spencer Morgan

10:30

Kathleen Cathcart

Charles McMahon

Jenny Motzer

10:45

Jamieson Greene

Perry Katsarakis

Gillian Minarik

11:00

Emma Hartman

Amanda Satterfield

Rhea Bandaru

11:15

& Yuke Li

Artemis Margaronis

Janki Bhatt

11:30

Cora Funke

Lara Gardiner

Anika Brahmhatt

11:45

Tatiana Jose-Santos

Gabby Glass

Malvika Khandelwal

12:00

L U N C H



AFTERNOON SCHEDULE

Time	Room 545	Room 613A	Room 613B
1:00	Piper LePree	Leah Dobres	Emma Kraus
1:15	Grace Newsom	Eleanor Olsen	Bridgette Lang
1:30	Jenna Riedl	Eleanor Horvath	Matthew Leal
1:45	Rebecca Sarkisian	Marie Kimball*	Erica MacDonald
2:00	Kristin Shanabrook	Jared Klinkowize	Izabella Rogers
2:15	Sara Strassel	Ryan Smith	Jacqueline Bachrach
2:30	Max Brown	Brianna Costilow	Kaitlyn Piotrowski
2:45	B R E A K		
3:15	Sanjana Ahmed	Scott Wade	Jared Pratt
3:30	Lydia Bischoff	Baiden Wright	Akshata Shukla
3:45	Cathy Cheng	Ruby Price	Nadira Sivabalan
4:00	Lauren Byerly	Giacomo Coraluppi, Will Krska, Nick	Madison Sofield
4:15	John Bolognino	Marchuk, Alex Zhou	Sydney Steger
4:30	Yash Patel	Nicholas Mangold	Martin Perez
4:45	Stanley To	Carter Fahey	Anna Rafferty
5:00	P R E S E N T A T I O N S C O M P L E T E		
5:30	Cocktail Reception at Kilachand Hall <i>Open to Kilachand Seniors, their families, Keystone Advisors, and Kilachand Faculty & Staff</i>		

*Content warning: mentions of rape, sexual assault



POSTER ABSTRACTS



Inhibitory neuron subpopulations in Area 25 in Stage II of Chronic Traumatic Encephalopathy

Nika Phoebe Kozlov

SAR, Human Physiology

Advised by Dr. Helen Barbas, Professor of Anatomy and Neurobiology, SAR

Chronic traumatic encephalopathy (CTE) is a neurodegenerative disorder that can present in individuals with exposure to repetitive head injury. Individuals who repeatedly experience micro-concussions are at risk of developing CTE, a disorder that progresses years after prolonged exposure to trauma. Early stages of the psychiatric disease are characterized by the onset of depression, emotional dysregulation, and aggression (Stages I and II), followed by memory loss and severe dementia in later stages (stages III and IV). This project examines how three distinct classes of inhibitory neurons (neurons which suppress signal transduction in the brain), parvalbumin (PV), calbindin (CB) and calretinin (CR), are impacted in Stage II CTE across all six layers of the cortex in Area 25. Area 25 is of particular interest to study as hyperactivity in this area has been associated with depression, one of the major symptoms seen in early stages of CTE. PV, CB, and CR inhibitory interneurons account for the majority of inhibitory neurons in the cortex. I used stereology methods to count each of the three types of inhibitory neurons in three cases diagnosed with Stage II CTE. I compared the counts I gathered to neurotypical brain data by calculating and comparing neuron densities for each case. Preliminary data suggests both PV and CB neuron densities decrease in Stage II CTE.

An exploration of the Swiss school system and factors affecting transfer rates to Gymnasium: Evidence from Canton Zürich

Isabel Mullens

CAS & GRS, Economics & Mathematics

Advised by Dr. Ishita Dey, Senior Lecturer of Economics, CAS

The Swiss education system differs significantly from the US system; after attending primary school, students in Switzerland can choose to continue to secondary school, attend vocational school or apply to gymnasium, a selective academically-focused public upper-secondary school comparable to a US college preparatory school. Attending gymnasium provides students with a direct pathway to university and past research has shown that students who attend gymnasium have a greater likelihood of obtaining higher-paying jobs. Motivated by a desire to understand factors that affect transfer rates from primary school to gymnasium, I created a novel dataset using data provided by Canton Zürich. The district-level dataset includes school-specific data such as class size, demographic information about students, and per-student expenditure. Using this data, I ran various Ordinary Least Squares regressions to explore factors that explain transfer rates.

I found that the transfer rate to gymnasium is affected by four key factors: the percentage of immigrant students, the percentage of low-income students, average class size, and the total population of the district. Most notably, the percentage of low-income students had a negative effect on transfer rates, while the percentage of immigrant students had a positive effect. Further, the positive effect of immigrants is weaker for school districts with high percentages of low-income students. These results support the findings of Hupka-Brunner et al. (2010) and Tjaden and Scharenberg (2017), and offer opportunities for reflection about cultural distinctions between public schooling systems in different countries. Overall, this project contributes to the understanding of factors affecting student achievement and could potentially inform future policies to promote equal access to academically rigorous education and mitigate barriers to upward economic mobility.

The Startup Toolkit: Building a Sustainable Competitive Advantage in the Fashion Industry

Ria Chawla

QST, Business Administration and Entrepreneurship

Advised by Dr. Peter Marton, Senior Lecturer of Strategy and Innovation, QST

The fashion industry is an everchanging and fiercely competitive market. This makes it extremely difficult for emerging businesses to enter the market, establish themselves as a brand and most importantly, sustain themselves against competitors. To remain competitive in the growing and crowded industry, startups need to differentiate themselves and build a unique advantage that sets them apart. However, this is easier said than done, and many startups struggle to identify and build this competitive advantage.

My project, The Startup Toolkit, is an E-book and Podcast series that coaches fashion startups on building a sustainable competitive advantage in the fashion industry. This guide provides a unique, hands-on approach that combines audio and visual modalities to help startups restructure their approach to starting a business in a more authentic, focused, and organized manner. Each podcast episode is accompanied by a set of notion templates that include resources like case studies, frameworks, and strategies to help the reader understand and apply what they've learnt. Additionally, the guide features a "Second Brain" master template that serves as an all-in-one virtual workspace to capture and organize ideas and track their progress throughout their entrepreneurial journey. Recognizing the importance of having a space for free-thinking and reflection, The Startup Toolkit encourages readers to "brain dump" their ideas and cultivate creativity and innovation. The ultimate goal of this guide is to provide actionable insights, tools, and strategies that will help emerging fashion businesses navigate the challenges of launching and growing a successful business.

The Belém do Pará Convention: U.S. Absence from the Inter-American Treaty Addressing Violence Against Women*

Maecey Jade Niksch

CAS, International Relations

Advised by Dr. Sofía Pérez, Associate Professor of Political Science, CAS

Violence against women (VAW) is a pervasive problem globally and is especially prevalent in the Americas. In the late 1980s, the Inter-American Commission of Women (Comisión Interamericana de Mujeres, CIM), a specialized commission of the Organization of American States (OAS), drafted the Belém do Pará Convention—a legally-binding international convention adopted in 1994 to prevent, punish, and eradicate VAW through the Inter-American human rights system. Since its adoption in 1994, the Belém do Pará Convention has become the most widely ratified international treaty in the Americas, and 32 out of 35 OAS member states have ratified it. Strikingly, the United States has not. To explain why, I examine three areas: (i) the U.S. tendency to attach reservations when ratifying international human rights treaties and the international community’s criticism of this, (ii) the limitations of the U.S. Constitution and federalist structure on ratifying international human rights treaties; and (iii) the U.S. government’s exceptionalist attitude regarding domestic VAW laws. Because of the restrictions of federalism and U.S. reservations to international human rights treaties, I argue that the U.S. government asserts exceptionalism in its own limited domestic VAW laws in order to justify its absence from the Belém do Pará Convention. Perhaps the most harrowing conclusion from my research is how U.S. absence from human rights treaties grants it impunity within the Inter-American human rights system, which has dire consequences for the ability of U.S. women to seek justice for the violence committed against them.

**Content Warning: Mentions of domestic violence*

Investigating the Role of Neutrophil Elastase in Liver Fibrosis

Max Kroll

CAS, Biochemistry & Molecular Biology

Advised by Dr. Qiong L. Zhou, Assistant Professor of Pharmacology & Experimental Therapeutics, BUCASM

Liver fibrosis is a consequence of obesity, in which proteins that hold cells together become much more abundant. This growth eventually causes buildup and scarring that compromises liver function. How this happens at the cellular level remains incompletely understood. My project examines the role of neutrophils in this process. A neutrophil is a type of immune cell that usually works to kill foreign invaders; however, they may also work to stimulate fibrosis. Neutrophils act on human tissue via an enzyme called neutrophil elastase (NE), which functions as a set of molecular scissors that allow neutrophils to achieve a cellular response. I investigated whether neutrophil elastase contributes to liver fibrosis by conducting several experiments on cultured liver cells in petri dishes. For example, I treated one set of cells with neutrophil elastase, left one set of cells untreated, and tested if there was a differential cellular response. To observe the cellular response, I primarily used immunostaining. This process allowed me to tag fibrotic markers so that I could image them under a microscope. If a marker of fibrosis such as collagen is brighter in one group, it is evidence that the treatment conditions of those particular cells stimulated fibrosis. I found that NE does seem to have an effect on fibrosis in liver cells. However, further studies must be done to establish the cell-signaling pathway of NE, as well as to verify my results using other biochemical methods such as gene expression and western blot. These results, if corroborated, establish inhibition of NE as a potential drug target for reducing obesity-dependent liver fibrosis.

Studies Toward the Synthesis of Remisporines A and B

Michelle Roos

CAS, Chemistry & Neuroscience

Advised by Dr. John A. Porco, Jr., Professor of Organic Chemistry, CAS

This study describes the efforts to synthesize remisporines A and B, two organic compounds that are naturally produced by a marine fungus. Biological studies have found that remisporine B displays antitumor activity against several human cancer cell lines in addition to antimicrobial, cytotoxic, and immunosuppressive activities. Considering the low yielding process of natural product isolation, we aim to develop an efficient synthetic route to produce remisporine B on gram scale, which will allow for further studies to elucidate its medicinal potential. We employ a biomimetic approach in our synthesis, inspired by the proposed pathway through which remisporines A and B are produced in nature. Our synthesis uses commercially available starting materials which can be converted into key intermediates toward remisporine A, the monomer of remisporine B.

Visualizing Anomaly Classification: Imaging Analysis for LANDSAT Data Archives

Alyssa Goins

CAS, Mathematics & Computer Science

Advised by Dr. Julio Castrillon, Research Assistant Professor of Mathematics & Statistics, CDS

This project provides a data visualization tool for anomaly detection analysis in Landsat imaging, particularly on Amazon Rainforest terrain. Landsat is a government-run program composed of satellites in Earth's orbit that record images of its surface, and accuracy in the analysis of these images can be affected by clouds that block full surface view. Boston University Department of Mathematics Professor Julio Castrillon's research group studies anomaly detection to address erroneous classification. I utilized the Matlab App Designer software platform to write the code for a graphic user interface (GUI) that displays the analysis the team is working on. Given an input Landsat file, the program displays the image in three panels: full-color, radar, and classifications. Below the three panels I include a window displaying either the image's anomaly sequence or the Elevated Vegetation Index sequence, depending on the tab selected. This GUI functions as an internal tool for the research team, as it creates an efficient and simple environment to view Landsat imaging anomaly analysis. This tool can be utilized in displaying and sharing data with a broader audience in order to share information on deforestation and climate change in the Amazon rainforest region.

α -MSH: A New Treatment for Ocular Inflammation?

Daryna Shnitser

SAR, Human Physiology

Advised by Dr. Andrew Taylor, Professor of Ophthalmology, BUCASM; Dr. Vasileios Zikopoulos, Associate Professor of Human Physiology, SAR

Inflammation is a normal immune response to injury and infection, but excessive inflammation can be extremely damaging. The eye is an immune privileged tissue, meaning that it has mechanisms in place to protect against excessive inflammation. Uveitis is the term used to describe inflammation of the eye, and it is responsible for 30,000 new cases of blindness in the U.S. each year. Corticosteroids are the current standard of treatment for uveitis even though they are not always effective and come with a long list of negative side effects. Alpha melanocyte-stimulating hormone (α -MSH) is a neuropeptide molecule produced in the eye that acts to suppress ocular inflammatory responses upon exposure to foreign agents that typically elicit inflammation. Unlike corticosteroids, α -MSH has no known ocular side effects. The aim of my study was to determine whether α -MSH treatment of RAW 264.7 macrophage-like immune cells can cause these cells to suppress the activation of inflammation following exposure to a toxin called bacterial lipopolysaccharide (LPS) via the programming of innate immune memory. The concept of innate immune memory challenges the idea that cells of the innate immune system are not capable of memory and suggests that α -MSH has potential applications in ophthalmology as a safer alternative to glucocorticoid treatments for inflammatory ocular pathologies.

COVID-19 and Obesity in Low-Income Communities Through a Social Determinants of Health Lens

Juliana Helfer

SAR, Human Physiology

Advised by Dr. Eileen O'Keefe, Clinical Professor of Health Sciences, SAR

With the lockdowns in 2020 due to Covid-19, individuals living in low-income and/or marginalized communities were forced to deal with the harsh consequences. Supply chain issues increased the cost of products, many minimum wage jobs could not offer a “work from home” option, and healthcare professionals became overwhelmed with Covid-19 patients. These effects of the sudden pandemic exacerbated the pre-existing health inequities for low-income and marginalized communities. Families were unsure about where their next meal would come from, how they would be able to pay rent, and how to get tested and vaccinated for Covid-19 due to limited accessibility of healthcare resources. In parallel, the ongoing obesity epidemic, which continues to worsen each year in America, has been shown to disproportionately affect low-income and marginalized communities. Obesity was identified by the Centers of Disease Control and Prevention as a comorbid condition that is linked to higher risks related to Covid-19. My research investigates how specific social determinants of health play a role in health outcomes in these communities. These social determinants include food deserts and food insecurity, transportation, and access to healthcare facilities. As part of my comparative analysis, I focused on Brookline, MA and Brighton, MA in order to bring awareness to disparities close to campus.

Lessons Learned from the VA Healthcare System: Implications for Healthcare Reform in the United States

Vikram Srinath

SAR, Human Physiology

Advised by Dr. Lisa Roberts, Lecturer of Health Sciences, SAR

The United States healthcare system is known for its high costs, lack of access, and inconsistent quality of care. However, the Veterans Health Administration (VA) provides healthcare services to over nine million veterans nationwide, making it unique in the US healthcare landscape as an example of socialized healthcare. There is a complicated relationship between healthcare policy and political ideology, particularly with regard to Republican veterans who receive and are satisfied with care from VA Healthcare while simultaneously holding beliefs traditionally opposed to socialized medicine. This implies that there could be a gap between political beliefs and the real-world implementation of healthcare, and that resistance to socialized healthcare might be more about rhetoric rather than factual experience or evidence. In order to gain further insight into how veterans feel about their healthcare, a survey of 21 veterans who are part of Veterans of Foreign Wars Massachusetts was conducted, showing a generally positive impression of VA Healthcare. Conversations with a veteran who held multiple positions working within the system and Dr. Paul Conlin, Chief of Medical Service of the VA Boston Healthcare System, highlight the challenges and benefits of VA Healthcare. These conversations provide insight into how the VA healthcare system can serve as a model for healthcare reform in the United States, especially in terms of its ability to enact successful reforms at a systemic level. The VA's commitment to expanding care and improving the quality of care for veterans can be a guiding principle for reform efforts.

Production of central tendency effects in interval timing tasks via reinforcement learning

Nicole Chiulli

CAS, Neuroscience

Advised by Dr. Ben Scott, Assistant Professor of Psychological & Brain Sciences, CAS

Interval timing refers to the ability of humans and animals to internally measure the amount of time that passes between two distinct events. This is analogous to an intrinsic stop-watch, which allows us to estimate and produce different lengths of time without the use of external time-keeping devices. Interval timing is an integral part of daily life as a human, but the underlying mechanisms used to accomplish it remain unknown. Interval timing deficits and abnormalities have been associated with various conditions, including ADHD, ASD, and Parkinson's; clarifying the mechanisms of interval timing may lead to an increased understanding of some aspects of these disorders and potential targets for new treatments.

My project investigates a particular behavioral pattern called the central tendency effect; in interval timing tasks during which participants are asked to reproduce a range of time intervals over many trials, responses are biased toward the mean of previous sample times. This creates a characteristic data curve in which longer sample times are underestimated and shorter sample times are overestimated. Current hypotheses in the field suggest the central tendency effects result from a form of Bayesian estimation utilized by the brain to increase timing accuracy. For my project, I have challenged this hypothesis by creating a series of computational models which simulate an interval timing task by following reinforcement learning algorithms, rather than Bayesian estimation. Despite the different methods, my models still produce central tendency effects in their time reproductions, indicating that reinforcement learning may be a viable alternative explanation for central tendency effects and that further research on the subject is indeed necessary.

A Qualitative Study of the Experiences of Frontline Medical Doctors in the United States during the Covid-19 Pandemic

Emily Vu

SAR, Health Science

Advised by Dr. Jacqueline M. Lauer, Clinical Assistant Professor of Health Sciences, SAR

COVID-19 has had major impacts on the lives of everyone in the world. As things slowly transition back to something similar to what it was like pre-pandemic, there is an understanding that things will never truly be “normal” again. The purpose of this qualitative research study is to examine the impacts of the COVID-19 pandemic on frontline medical doctors located on the East Coast of the United States working throughout the COVID-19 pandemic, specifically those in pulmonology and emergency care settings. As hospitals filled with COVID patients, these doctors, already facing numerous challenges in their careers, suddenly found themselves at the forefront of healthcare provision in the United States. Thus, this study seeks to both understand their experiences and explore methods to better prepare the medical field for the next “big thing”. A qualitative approach with semi-structured, in-depth interviews was taken in order to understand the experiences with topics such as personal protective equipment (PPE) shortages, mental exhaustion, witnessing patient death, job dissatisfaction and burnout, and fear of exposure and infection to COVID-19 itself. Recommendations for future preparedness were also explored. The findings from the research show a vast range of experiences and outlooks from medical doctors working throughout the pandemic, with a common theme of feeling a lack of preparedness for COVID-19. At the same time, individual experiences working during the peak of the pandemic ranged from immense feelings of burnout to a sense of purpose and satisfaction, and differing levels of optimism for the future.

Cytospinning Apparatus for Cancer Diagnostics

Olivia Lewallen

ENG, Biomedical Engineering

*Advised by Dr. Hannah Peterson, Postdoctoral Research Fellow,
Harvard University Center for Systems Biology*

In cancer diagnostics, cytospinning is a prominent technique used to process biopsy samples for imaging. Cytospinning is the process by which cells suspended in fluid are exposed to an applied force and since the cells have greater momentum than the fluid, they leave the fluid behind and disperse concentrated onto a slide. Through the college of engineering, my senior design team is working with a diagnostics company called Aperture Bio. Biopsies are collected at clinical sites and then sent to Aperture Bio for processing and analysis via cytospinning, staining, and imaging for biomarkers. Biomarkers are a measurable substance (proteins, molecules, etc.) in an organism whose presence is indicative of some phenomenon such as disease or infection. The imaging of cytospinned cells allows for detection of biomarkers via immunofluorescence. The specific biomarkers detected are then analyzed to determine cancer type and severity, and the results are reported back to clinics. The current system used by Aperture Bio for cytospinning has flaws that decrease processing capacity by 50%, significantly delay processing with backordered items, and require one-use plastic waste. This project will serve to improve upon the cancer diagnostics process by creating a new reusable cytospinning apparatus with increased sample capacity and in-house manufacturability. This will ensure efficient sample processing and quicker results for patients, doctors, and other company partners.

Kilachand's Perspective: Qualitatively Assessing Factors Influencing KHC's Retention Rate

William Owens

SAR, Human Physiology

Advised by Dr. Samuel Cook, Clinical Associate Professor of Math Education, Wheelock

The Kilachand Honors College has undergone multiple revisions under two different directors. Despite this, the retention rate has hovered around 50%, being slightly lower in the first few years and higher in more recent years. As a student in Kilachand myself, I saw many students leaving the program for a variety of reasons. I decided to investigate some of the reasons that students might choose to drop Kilachand and discover any common themes. I also analyzed whether or not the reasons for student attrition have changed over the years.

In order to investigate this, I contacted every student who has gone to Kilachand along with Kilachand faculty and staff to ask if they would like to be interviewed about their experience in Kilachand. After receiving an abundance of volunteers, my advisor and I interviewed all of the volunteers. The interviews were recorded on Zoom and later transcribed. I compared factors that led students to drop the program, and analyzed common themes of the experiences of students who dropped. I also analyzed common factors that caused students to remain in Kilachand. I uncovered ideas from students, faculty, and staff about what Kilachand should be, some of the problems it has, and how they might be fixed. From this, I learned more about the positives and negatives of the Kilachand program and can isolate factors that influence the retention. I hope this will lead to changes that will improve the students' experience at Kilachand and lead to a higher retention rate.

The Subjectivity of Emotions

Sofia Marcelli

CAS, Earth & Environmental Science

Advised by Dr. Sam Ling, Associate Professor of Psychological & Brain Sciences, CAS

Inspired by the synthesized artistic works of Oskar Fischinger, and other such artists as Roland Wakelin and Roy de Maistre, this project combines fine artistry and music production to promote deeper thinking about how people experience emotions. In this informal study, participants were prompted to choose and mark a point of emotional equivalency between visual and auditory stimuli, and in doing so demonstrate their own point of emotional intensity.

In the modern world, most interactions are conducted on screens, where everything has the potential to mean something else. In the media, movies, politics, and even in science, potential double meanings can lead to arguments and confusion. By allowing people to find their own subjective equalities, and view the subjective equalities of others, this informal study seeks to demonstrate how interpretation can change between one person and the next. This project is ultimately meant to create a space of deeper understanding and awareness of humanity's intrinsic differences and similarities, to promote mindfulness in future interactions.

College Students' Views on Celebrity Endorsements & Corporate Social Advocacy

Sophie Li

CAS, Psychology

Advised by Dr. Tobe Berkovitz, Professor Emeritus of Advertising, COM

How do celebrity endorsements and corporate social advocacy campaigns – that is, when an organization or company takes a public stance on social-political issues - affect consumer behavior? My research focused on a specific demographic – college students – in order to determine their perceptions of companies that partner with celebrities who are politically or socially active. I also examined the extent to which such campaigns and marketing tactics affected their behavior as consumers.

I developed a survey to examine if certain demographics, such as gender, race, or if the participant considered themselves to be socially or politically active influenced how individuals felt about certain advertisements. My questions were intended to discern whether young adults felt that it was important for companies to have social advocacy or whether they perceived such efforts to be empty promises. I examined multiple different campaigns from various companies that all featured some form of corporate social responsibility, to see what college students found the most effective. The results from this study can provide companies with more specific and nuanced data from their intended consumers, which may inform corporate decision-making regarding efficacious endorsements and/or partnerships with celebrities.

PRESENTATION ABSTRACTS



No Walk in The Park: Associations between Psychopathy and Physiology during Social Stress

Rutva Bhatt

CAS, Biology & Psychology

Advised by Dr. Nick Wagner, Assistant Professor of Psychological & Brain Sciences, CAS

Callous-Unemotional (CU) traits encompass low levels of fear, empathy, guilt, and prosociality, and indicate risk for antisocial behavior and psychopathy. Typically, CU traits have been linked with blunted autonomic nervous system (ANS) arousal, although some studies have not been able to replicate these findings. One way to measure the ANS sympathetic stress response is through recording skin conductance responses (SCRs) via changes in the conductance of electricity across the skin. A common way to measure ANS parasympathetic relaxation is through respiratory sinus arrhythmia (RSA), the concordance between breathing and heart rate. To help clarify the association between CU traits and ANS functioning, we conducted a multiple regression analysis using data from 50 college students aged 18-22 years old ($M = 19.61$, $SD = 1.25$). Students' SCRs and RSA were measured during a modified version of the Trier Social Stress Test (TSST), a series of tasks designed to induce social stress. Tasks included preparing and delivering a speech about family (Prep and Speech), discussing an aggressive parent-child situation (Park), discussing an agitating peer situation (Coffee), and an arithmetic task (Math). Results indicated that SCRs per minute predicted CU traits only during the Park task of the TSST, while RSA did not significantly differ between individuals nor across the TSST. These results suggest that CU traits may be associated with higher, rather than lower, sympathetic activation particularly when discussing aggressive family situations. Future research should examine ANS activation in different contexts to discern more about the connections between psychopathy and physiology.

Aloha Optimal Tourism: Economic Tradeoffs of the Travel and Tourism Industry in Hawaii

Aiden Cliff

CAS & QST, Business Analytics, Economics, & Finance

Advised by Dr. Jetson Leder-Luis, Assistant Professor of Economics, QST

Tourism is the largest industry in Hawaii, generating \$17.75 billion in visitor spending per year, supporting more than 200,000 jobs, and composing 22.8% of Hawaii's economic output in 2019. Despite this success, there are downsides to an overreliance on tourism including under-investment in sustainable industries amongst other tradeoffs. These issues were exposed by COVID-19 and its consequent travel restrictions. In 2019, Hawaii received over 10 million visitors to the islands, but that number fell by more than 75% in 2020, allowing us to consider what Hawaii would look like in the absence of tourism. Observing both of these extremes – high tourism or nearly no tourism – suggests the optimal number of visitors to Hawaii lies somewhere in between. Hawaii needs to further invest in Optimal Tourism or Destination Management practices to better navigate the tradeoffs within the tourism industry. This paper utilizes quantitative and qualitative analysis to prove that Hawaii falls victim to the natural resource curse and has become over-reliant on tourism leading to a weak education system and a dependence on unskilled labor. To support more stable economic growth, Hawaii should seek diversification initiatives in the film and agricultural industries.

Gathering Space: A Model for the Museum of the Future

Spencer Morgan

CFA, Theatre Arts - Design & Production

Advised by Dr. Carrie Preston, Director of Kilachand and Professor of English and Women's, Gender, & Sexuality Studies, CAS

Gathering Space: A Model for the Museum of the Future is a critique of contemporary cultural institutions that fail to be physically accessible, narratively inclusive, and experientially exciting. My project has three distinct components that together communicate how these overarching issues are embodied in traditionally designed exhibitions reliant upon physical space; a placed-based investigation of over forty exhibitions, a design intervention for exhibits, and a treatise on how improved exhibition design correlates to better cultural institutions. The entirety of the public is not benefiting from cultural institutions because they rely upon a building in which to carry out their mission; people must be able to travel to this space, people must be able to navigate this space, people must be able to derive meaning from this space. *Gathering Space* presents a way forward for these cultural institutions that is not reliant upon historically inaccessible, exclusive, and boring spaces: virtual reality place-based interpretive experiences that are free. *Gathering Space: A Model for the Museum of the Future* is itself a proposal for the future form of cultural institutions based upon the paradigm of experience design: provide opportunities *for all* to engage.

Pressure to Post?: How Political Science Majors Conceptualize Their Political Obligation on Social Media

Kathleen Cathcart

CAS, Political Science

Advised by Dr. David Glick, Associate Professor of Political Science, CAS

Born out of reflection on my past social media practices, this study evaluates how political science students' academic identity impacts their posting practices. While research reveals that modern students feel a sense of duty to promote and defend their political beliefs online, studies have yet to focus on the attitudes and behaviors of the students inextricably linked to politics: political science majors. I investigated what motivates political science students to, or not to, post political content and how these decisions align with their understood academic and social expectations.

Run concurrently over a five-month period, this study used two methods: qualitative focus group meetings with five political science students and a content analysis of twenty-five undergraduates' Instagram posts. Ultimately, my combined research findings support the existence of a political poster spectrum on which not just students, but all social media users, fall at different points due to varying levels of maturity, genuine political interest, offline political involvement, and pressure. This study does not find political science students responsible for sharing political content with significantly greater observable frequency than students of other majors. It determines the pressure to post which affected the interviewed political science students was self-imposed, based on the supposed expectations and actions of a model political science student. These findings point to the overlapping pressures of being a student as well as a citizen which can affect the behavior of those who choose to study political science today.

Measuring COVID-19 mRNA Vaccine Effectiveness

Charles McMahon

SAR, Human Physiology

Advised by Dr. Sophie Godley, Clinical Associate Professor of Public Health, SPH

The COVID-19 pandemic put our healthcare system to the test. While many weaknesses and disparities have been revealed, the scientific community responded in record breaking ways. mRNA based vaccines against COVID-19 were developed, tested, and rolled out in a matter of months. While these vaccines have been shown to be safe, it is still necessary for the medical and scientific communities continue to monitor how well these vaccines are working at combating the virus. As the virus has continued to mutate, the effectiveness of the mRNA vaccines has also changed. Through large sample studies such as the IVY Network, we can see how these vaccines combat viral illness in different populations. In this paper, the results of two publications from the IVY Network are analyzed. One paper examines the effects of multiple vaccine doses during the Omicron variant surge and the other examines the effects of bivalent booster vaccines rolled out in fall 2022. The findings of these papers are then contextualized with other studies on COVID vaccine effectiveness. This paper also aims to explore why vaccine effectiveness data is collected and how it can influence health policy and the attitudes of the general public.

Control Networks of Voluntary Visual Temporal Attention

Jenny Motzer

CAS, Neuroscience

Advised by Dr. Rachel Denison, Assistant Professor of Psychological & Brain Sciences, CAS

What are the neural substrates of voluntary temporal attention in visual processing? Temporal attention, or the ability to direct attention to moments in time, increases perceptual sensitivity to visual information. However, the control networks underlying the allocation of temporal attention remain understudied. Previous neuroimaging research suggests the involvement of the intraparietal sulcus and cerebellum in the control of temporal attention. However, these studies were limited due to their use of group averaging, which overlooks individual variability of activity patterns.

We performed high resolution within-participant investigation of temporal attention using functional Magnetic Resonance Imaging (fMRI) to investigate candidate regions of interest in temporal attention control networks. Human participants underwent fMRI while performing a two-target temporal cueing task. The temporal cueing task manipulated voluntary temporal attention with valid, neutral, and invalid trials. This allowed comparisons of neural activity when selectively attending to a single target in time versus sustaining attention to both targets. I used univariate whole-brain analyses to create a map of regions actively involved in voluntary temporal attention modulation. I performed contrasts between conditions to find brain regions active during the selection process of temporal attention. I found significant activity in the inferior frontal gyrus, intraparietal sulcus, supramarginal gyrus, middle frontal gyrus, and pars triangularis across participants. Several of these identified regions are linked to complex cognitive functions such as time perception, executive function, eye movement control, and visual perception. This experiment provides an expansion on previous research by highlighting previously overlooked candidate control networks of temporal attention.

The Ethics of Synthetic Meat Production: A Utilitarian Analysis

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Advised by Dr. Susanne Sreedhar, Professor of Philosophy, CAS

What are the ethics of eating a Big Mac? Food is central to daily life; it is essential for nutritional sustenance, an outlet for creativity and expression, and a source of joy. Despite such prominence, questions of food ethics are often neglected; this paper seeks to redress this problem.

Industrial agriculture is the preeminent source of meat in the United States, yet its production comes at great expense to the farmer, animal, and consumer. However, many current plant-based meat alternatives fail to either satisfy nutritional and gustatory interests or ameliorate the most significant health, economic, and environmental pitfalls of industrial agriculture. Synthetic meat presents a new and exciting alternative to factory farming, allowing consumers to enjoy real meat without slaughter.

In this paper, I analyze the ethics of synthetic meat production at commercial scale, limiting “ethics” to utilitarianism. Bentham’s and Mill’s utilitarian philosophy serves as the foundation to this argument, and this paper applies the Greatest Happiness Principle, analyzing this production alternative’s impacts on the animal, broad society, and individual consumer. This paper concludes that synthetic meat is more ethical than factory farming. However, in response to the somewhat theoretical nature of this paper, I retain caution and offer recommendations for the production of synthetic meat to preserve its superiority. This paper contributes to the greater conversation about ethical consumption particularly as it relates to food. I analyze factory farming and synthetic meat according to utilitarian theory and conclude that synthetic meat produces greater overall happiness.

Boosting the Chemotherapeutic Effect of Cancer Drugs using Focused Ultrasound (FUS)

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ENG, Biomedical Engineering

Advised by Dr. Seung-Schik Yoo, Director of the Neuromodulation and Tissue Engineering Lab at Brigham and Women's Hospital and Harvard Medical School

Around 39.5% of individuals in the United States will be diagnosed with some form of cancer during the course of their life. Over 100 different drugs have been approved for cancer treatment, many of which are systemic therapies, meaning they circulate through the bloodstream. In the blood, these drugs can bind to blood plasma proteins such as albumin. When binding occurs, the resulting drug-protein complexes are sequestered in the bloodstream, reducing effective drug delivery. One potential solution to improve drug delivery is to increase the systemic dose; however, this approach is infeasible for chemotherapy agents, where higher doses are often associated with serious side effects. This necessitates a new technique that can increase the unbound concentration of a chemotherapy drug. Research has shown that low-intensity focused ultrasound (FUS) produces forces that can temporarily disrupt plasma protein binding (PPB), locally increasing unbound drug concentration. Using a mouse model, we applied this technique to unbind cisplatin, a chemotherapy drug that binds to albumin at a rate of over 95%, in order to examine if FUS can enhance the delivery of unbound cisplatin to cervical cancer and thus boost treatment efficacy. We found that a combination of cisplatin and FUS caused a significant reduction in tumor volume compared to the use of cisplatin alone. This study provides the first evidence that FUS offers unprecedented improvements in the non-invasive enhancement of chemotherapeutic agents with high PPB rates. This technique may allow for the use of lower systemic doses to yield equivalent treatment outcomes.

Spin-Correlated Resonance Raman Enhancement in a 2D Antiferromagnet

Gillian Eleanor Minarik

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We are experiencing the second quantum revolution. Researchers around the world are exploring materials host to exotic condensed matter physics which could be used in the development of next generation quantum-based information technologies. Atomically thin magnetic crystals are particularly interesting as they exhibit long-range ordering of spins below a critical temperature. However, the origins of this magnetic order and its interplay with the optical, vibrational, and electronic properties intrinsic to these crystals are not well understood. This project focused on nickel phosphorus trisulfide (NiPS₃), a crystalline material in which adjacent nickel atoms have antiparallel spin alignment below $\sim 152\text{K}$. Raman spectroscopy, an inelastic scattering technique, was employed to study the vibrational modes of NiPS₃ and investigate how these vibrations are correlated to the electronic structure and magnetic order. Raman excitation dependence measurements identified a resonance feature at 2.2eV , revealing a previously unassigned electronic transition in NiPS₃ with this energy. Further temperature-dependent experiments suggest that the antiparallel spin configuration may facilitate the corresponding 2.2eV transition, leading to enhanced Raman intensity below 152K . A thorough analysis of the spectral data reveal additional insights into the relationship between the magnetic order and specific vibrational modes when the material lives in different excited electronic states. A fundamental understanding of spin-correlated phenomena helps to unravel the complex picture of the many-body interactions in NiPS₃ and similar materials exhibiting magnetic order. These interactions may be harnessed to achieve optical spin control, with applications in energy conversion and higher order data processing and storage.

Software for Closed Loop Neurofeedback

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Previous studies have shown that slow wave sleep (SWS) provides many cognitive benefits, including improved memory and sleep quality, as well as a positive impact on many biological processes such as glucose metabolism, hormone release, and immunity. Furthermore, prior research suggests that introducing auditory stimulation in phase with these slow waves effectively increases their magnitude, amplifying their beneficial effects. We aimed to develop a MATLAB algorithm that built upon this research by using appropriately timed sound stimulation to enhance users' quality of sleep when paired with a commercially available electroencephalography (EEG) headset. While similar research-grade software exists, this algorithm is intended for use in a home environment. We connected a MuseS EEG headband to our MATLAB computer application via a Bluetooth connection with a sampling rate of 256 Hz. We then collected preliminary EEG data to train a Recurrent Neural Network (RNN) to predict the phase angle of slow wave oscillations in real-time. After conducting a literature review, we theorized that the RNN architecture was most conducive to this goal due to its ability to process sequential data in a feedback loop, thus allowing us to identify slow waves and examine phase changes in acquired EEG data. After training and optimization are complete, we will use our RNN model to predict and deliver an auditory stimulus in phase with identified slow waves so as to enhance their magnitude. We will analyze our results by calculating the amplitude of error for our predicted phase angles via a polar histogram method.

Selective Ensembles: Product or People

Amanda Satterfield

CFA, Music

Advised by Dr. Kinh Vu, Assistant Professor of Music & Music Education, CFA

Immigrant and English Language Learner (ELL) students face a very different schooling experience than their domestic or English-speaking counterparts. This includes, but is not limited to, adjusting to a new environment, communication barriers, stereotyping and lack of cultural acknowledgment. Music education in the United States, particularly in ensemble settings (band, orchestra, etc.), is known to often foster competitive environments that hold tightly to musics within the Western canon, excluding students who might not contribute in a way deemed satisfactory. With immigrant and ELL students already vulnerable in the mainstream school environment, participation barriers are perpetuated. In an effort to explore methods of meaningful music inclusion for all types of students, this research project investigates music teachers' decisions to adhere to or stray from conventional and rigid standards. Through student surveys and one-on-one teacher interviews of a Boston metro-area public school district, which hosts a large number of immigrant and ELL students, I examine how teachers work towards inclusivity and how students perceive they are being included (or not). Qualitative analysis of this data revealed that the majority of students are experiencing a different music at home and are unsure about continuing their participation in music in high school. Many music educators are taking steps to cater to student's diverse experiences; however, some ideological divides are evident between older and younger teachers. This data suggests that a continued need for teacher reflection and critical examination of what is deemed "important" to include in musical offerings may be integral in an effort to encourage ELL and immigrant students in school music.

The Ideal Woman Leader: Behaviors & Perceptions of Women in Corporate Leadership

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CAS & Qu, Business Administration and Analytics & Computer Science

Advised by Dr. Carrie Preston, Director of Kilachand and Professor of English and Women's, Gender, & Sexuality Studies, CAS

Women have historically been underrepresented in the executive offices of business fields like finance and consulting. Though there have been industry-wide shifts to try to encourage diversity in upper-level management within the past decade, executives continue to be predominantly men from similar educational, socioeconomic, and racial backgrounds. Despite masses of women moving into middle management positions within the past few decades, a notable lack of women within upper level management continues to exist within this field. This literature review will focus on examining studies and other works that analyze the gendered behaviors and leadership styles that women and men exhibit within the workplace. Such analyses will delve into what behaviors are defined as feminine and masculine and what responses they encourage in corporate environments. This will provide a greater understanding of the double bind that women experience when displaying both feminine and/or masculine traits in leadership and the effectiveness of such behaviors in ascending to executive positions. Through this analysis, we can gain a better understanding of how women can achieve long-lasting success in upper-level, corporate leadership.

High-throughput In Vitro Assessment of Paracrine Factors in Cardiac Fibrosis

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The pathological buildup of extracellular matrix (ECM) after cardiac injury or disease can disrupt tissue healing and function as the damaged heart undergoes a fibrotic response. This leads to an increase in collagen production and the formation of stiff scar tissue, causing the heart to pump less efficiently over time. This process, called fibrosis, is mediated through the activation of fibroblast cells, increasing their proliferation and ECM deposition. While fibroblasts are known to be activated in response to injury and disease due to cell signaling from paracrine (growth) factors secreted by immune cells, the specific effects of individual paracrine factors on cardiac fibroblasts are not well understood. We hypothesize that some paracrine factors associated with fibrosis only activate fibroblasts in the presence of additional paracrine factors. To address this gap in literature, we developed an in vitro microtissue model to study the synergistic effects of the paracrine factors, Transforming Growth Factor Beta (TGF- β), Epidermal Growth Factor (EGF), and Fibroblast growth factor (FGF), on the fibrotic process. Utilizing this model, we characterized the isolated and combined effects of TGF- β , EGF, and FGF on fibroblast proliferation, the kinetics of cell-cycle progression, and ECM deposition and remodeling. Our findings show that unlike EGF, TGF- β and FGF alone do not significantly enhance fibrotic remodeling, but they can contribute to it in synergy with other factors. By characterizing the role of these paracrine factors in the fibrotic process, we provide insight into potential improved therapeutic targets to treat fibrotic remodeling in the heart after injury.

Grief Lost and Found: Diversifying Sources on the 1971 Bangladesh Liberation War

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The harrowing events of the 1971 Bangladesh Liberation War are poorly recorded and understood. 1971 marked the creation of the People's Republic of Bangladesh (then East Pakistan) after a year-long struggle with opposing forces from (then West) Pakistan. Often referred to as the Bangladesh Liberation War, this conflict caused death and destruction on a massive scale. Notably, it led to the displacement of ethnic communities—the ethnic Bengalis of Pakistan and Biharis in Bangladesh—who have remained stateless for nearly fifty years as a direct consequence of xenophobia perpetuated by newspapers in 1971. These journalistic narratives from 1971 remain a point of contention between Bangladesh, Pakistan, and India to this day. While academic sources have attempted to resolve this dispute by discussing large-scale political and social consequences, they fail to capture the nuanced emotional and psychological effects of the War on affected populations. This project studies the stories and memories of affected communities that were preserved through literature in the form of short stories, testimonies, and essays. By comparing them to sources from academia and journalism, my project shows that each type of source—fictional, journalistic, and academic—provides key information on the conflict; only by diversifying sources can one gain a holistic understanding of this War and other such conflicts. The project concludes that memorialization—the process of recording testimonies, stories, and oral accounts—is an essential tool for understanding and ameliorating the challenges engendered by conflicts like the Bangladesh Liberation War.

Mapping Mutual Aid Resources in Boston

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Mutual aid is the cooperative exchange of resources and services within a community. At the beginning of the COVID-19 pandemic, informal support networks became more common as people came together to help each other in a time of need. Dozens of thriving mutual aid groups were created in the Boston area. However, because of their grassroots nature, it was difficult to find available resources. Through my Keystone Project, I aimed to map mutual aid resources and better understand their existence in Boston. For the first part of my project, I created an online map of over 70 mutual aid resources in the Boston area including community fridges, mutual aid pods, and buy nothing groups. The map provides links to websites and social media pages. The goal is to help people in need gain access to resources and to encourage people to give when they have extra. For the second part of my project, I researched historical examples of mutual aid, the political theories behind it, and conducted qualitative research to contextualize the map. Using participant observation and semi-structured interviews, I spoke with 10 community organizers to better understand how mutual aid groups are structured, the challenges they face, and how their efforts are sustained over time. My research suggests that while specifics vary across neighborhoods, the need for localized community-based support in the Boston area is high. Mutual aid is a crucial way communities care for each other when institutional supports fail.

View the map here: <https://tinyurl.com/mutualaidmap>

What Fruit Flies Reveal to Us About the Relationship Between Serotonin and Circadian Rhythms

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Advised by Dr. Kyle Gobrogge, Lecturer of Neuroscience, CAS

Circadian rhythms are an essential feature of the biology of all living organisms to acclimate to environmental changes and increase survival. Perturbation of the systems driving circadian rhythms, such as altering serotonin levels, are thus correlated with a variety of mood disorders and sleep disruptions. Several therapies have been created to circumvent the negative effects of sub-optimal serotonin levels, such as Bright Light Therapy (BLT). Although viable, there is a lack of research on certain specifications required to optimize BLT's therapeutic effects such as color temperature of the light and which specific symptoms of depression are alleviated. Therefore, this study investigated how different color temperatures can mitigate sleep related symptoms of depression. Specifically, I examined the role of serotonin in the circadian rhythms of a fruit fly by using a common gene editing system to silence all serotonin neurons in the brain and subsequently monitor fly activity over 72 hours. Then, I conducted another experiment to observe whether serotonin silenced fruit fly activity changed with light temperature. I monitored activity under 2700K light and 6500K light temperatures. Both serotonin silenced and serotonin active fruit flies showed morning and evening activity peaks. Flies with serotonin silencing show greater activity at both morning and evening peaks with less rest during the middle of the day compared to their serotonin active counterparts. Further, there was increased morning activity under 6500K light conditions, but increased evening activity under 2700K conditions. This study reveals possible light therapy interventions for those experiencing symptoms of depression due to lower serotonin levels associated with the mood disorder.

Shirley Jackson's *Hangsaman* and Fractured Female Identity in the Gothic

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Gothic tales are known to make subversive social commentary through their macabre style. The female Gothic, specifically, explores gendered oppression and family trauma, including the taboo subjects of sexual trauma and incest. Mid-20th century Gothic writer Shirley Jackson explored these themes in many of her novels and short stories. Her second published novel, *Hangsaman* (1951), blurs the line between reality and imagination in the story of seventeen-year-old Natalie Waite. The reader follows Natalie on her journey to form a stable identity in college in the wake of a dysfunctional family and an acute sexual trauma. My project, a literary magazine article, examines *Hangsaman* in the context of the broader female Gothic genre and Jackson's own life. Analyzing the novel primarily through a queer and feminist theoretical lens, I posit that *Hangsaman* defies the traditional coming-of-age narrative by showing a failure of the protagonist to form a stable identity. Further, I argue that this failure is a result of the social structures around Natalie, rather than a result of her individual weakness. For this reason, *Hangsaman* could be regarded as a nihilistic portrait of American girlhood—but what can we learn from it?

Todo en Buena Comida (All in Good Food). Taking the First Steps in Providing Culturally Sensitive Health and Wellness Content.

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Despite the multitude of Latin cookbooks produced each year, few focus on combining traditional Latino recipes with a healthy lifestyle. In the United States alone, 45 million Americans partake in novel diet schemes. Subscribing to diet culture often means subscribing to a predefined ideal, set by society, of the criteria for a healthy individual. While current diet trends have shifted from promoting thinness to focusing on overarching ideals of health and wellness, the industry still lacks inclusivity on what health might look for different individuals and different cultures. In an industry that values at over \$78 billion only a handful of these lifestyle products, applications, and interventions cater to the Latino population.

My research focuses on how the relationship between health interventions and health outcomes are influenced by cultural relevancy. Literature available on culturally sensitive health interventions within the Latino community is scarce. Within the studies that do exist the sample sizes are often small and lack in depth statistical data. These gaps in knowledge indicate an unexplored market that spans the wellness industry, cookbook industry and the Latino market.

I applied this research to develop a cookbook format that uses traditional Latino recipes to create healthier alternatives. It provides health and lifestyle instruction in comprehensive and appealing ways. I aim to encourage healthier living styles among the Latino population while maintaining the cultural integrity of popular dishes. Through researching what was available currently on the cookbook market, cookbook design trends, as well as holistic nutrition and wellness I was able to create a detailed template and cookbook proposal for publishers, fit with sample recipes, instructions and styled recipe images.

Highlighting Indigenous Strength Among Assumptions of Disparity: The Success of COVID-19 Vaccination in Navajo Nation

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Advised by Dr. Muhammad H. Zaman, Professor Biomedical Engineering and International Health, ENG & SPH

At the height of the pandemic, Indigenous populations in the US were hit the hardest by COVID-19. When vaccine rollout began, however, Indigenous communities took the lead in the vaccination effort, achieving the highest vaccination rates out of any racial group in the US. Navajo (Diné) Nation achieved especially outstanding rates. By May of 2021, over 85% of Navajo over the age of 16 were vaccinated. To date, there are no studies that analyze these outstanding initial vaccination rates among Navajo communities within the historical context of Indigenous healthcare access and past vaccination trends in response to disease outbreaks. The objective of this project is to understand the factors, and reflect on society's preconceived notions, surrounding the rates of COVID vaccination in Navajo Nation, within such a historical context. To answer our research questions, we conducted an extensive literature review of existing analyses on the Navajo vaccination response and the factors involved. We analyzed vaccine data for Navajo regions, comparing COVID vaccination to flu and childhood vaccination, as well as the Navajo response to the H1N1 outbreak. Additionally, we spoke with researchers and doctors who shared their own perceptions surrounding the Navajo vaccination effort. The results of this project suggest several core arguments: The COVID vaccination rates among Navajo communities are impressive and were due to a combination of internal, multi-level factors within Navajo Nation. These rates were not new, but rather were a continuing trend within the community. Therefore, COVID is important but not an anomaly. Finally, the Navajo vaccination response is a case study of resilience that allows us to question our personal biases surrounding Indigenous health equities, public health expertise, and the role of anthropology in epidemiological studies.

The Role of Gender Identity on Individual's Definition of Science and Identification with Science

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Advised by Dr. Deborah Kelemen, Professor of Psychological & Brain Sciences, CAS

This project examines how people's personal definitions of what it means to do science influences their perceptions of their own belonging in science, or their science identity. I also researched the impact of gender, specifically, whether males and females differ in their science identity. Especially since research has found science identity plays a greater role in shaping participation in science for girls compared to boys (Vincent-Ruz & Schunn, 2018). Through a survey, data was collected on a diverse sample of U.S. adults ($n = 255$; 49.8% female, 50.2% male, $M = 38.9$ years old). Participants were asked what it means to do science, the degree to which they see themselves as belonging in science (self-science identity) and the degree to which they think that others see them as belonging in science (other-science identity). I also put forth a series of questions asking for individuals to categorize traditional science topics and activities (e.g., biology) and non-traditional science activities and topics (e.g., playing in the dirt) as scientific or not. Through statistical analysis, it was found that while an individual's self-science identity is not influenced by their personal science definitions, there are gender differences between the relationship of personal science definitions and other-science identity. These results are important in shedding light on understanding how men and women perceive their own science capabilities through the lens of others simply based on how they define science.

Understanding Imposter Syndrome: The Associations Between Imposter Phenomenon, Overgeneral Autobiographical Memory, Shame, and Depression

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Imposter Phenomenon (IP) is the internal experience of individuals inclined to think that their high achievements were due to luck or a mistake. IP is often prevalent in academic and vocational environments, and much research conducted thus far has focused on these populations. One variable that could be related to IP is overgeneral autobiographical memory (OAM), which is the tendency to summarize personally experienced events in a general fashion, as opposed to recalling a single, specific event or episode. OAM is thought to contribute to an individual's sense of self, and hence it has a potential link to IP. It could be possible that individuals who experience IP may have difficulty recalling specific memories regarding past accomplishments, and instead recall overgeneral memories about their personal experiences. Additionally, feelings of shame and depression may be more impactful to those who experience IP. This study predicted that individuals who exhibit significant symptoms of IP will recall more overgeneral memories, as opposed to specific memories. Additionally, individuals who exhibit significant symptoms of IP will be more sensitive to feelings of shame, as well as exhibit higher levels of depression and rumination. To investigate the relationship between these variables, the study first evaluated OAM using an interview-based assessment. Participants (n = 120) were given a series of cue words (i.e., confident, scared, rude) and were asked to recall a memory they associate with that word. Next, participants took a series of questionnaires assessing IP, shame, depression, and rumination. The results of this study may help professionals understand the manner by which symptoms of IP develop in relation to the generalization of memories regarding past achievements and accomplishments.

Fandom and Fashion: Ethnographic Analysis of College Football Fan Culture

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Sports fandom contributes to group identity because fans view their favorite teams as symbolic representations of desired aspects of social or community life. College football's locally inflected fandom lends itself to group identity formation in which a team represents a certain city, state, or region. In this project, I study gameday fan culture with an emphasis on class signifiers through participant observation, informal interviews, and audiovisual media collected at four universities that sponsor NCAA FBS football in the American South, Midwest, and Northeast. I observed unique traditions and fan experiences at each fieldwork site and noted common themes of racially homogenous fanbases and family ties. I analyzed my ethnographic data through the lens of Pierre Bourdieu's concept of habitus, which informed my understanding of social patterns and inequalities embodied by the aspects of identity that each group of fans emphasized through fashion, food and drink, tailgating locations, admiration of team legends, and attitude towards winning. My research shows how college football's unique ability to strengthen group identity impacts the fan's identities by creating or validating aspects of their personhood, particularly a sense of belonging to a place and the shared values and culture that place represents.

Exposing the Care Gap: How Socioeconomic Status interacts with Pediatric Mental Health Care

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“Among children living below 100% of the federal poverty level, more than 1 in 5 (22%) had a mental, behavioral, or developmental disorder.” - Centers for Disease Control and Prevention

There are a unique set of obstacles low income families in the United States may face due to their economic status; structural and attitudinal barriers to higher quality resources and a vicious cycle of emotional and social neglect. My project explores these barriers to pediatric mental health care and demonstrates how they differ due to demographics such as ethnicity, age, and socioeconomic status (SES) via a visual and interactive software to express the gravity of this gap in care. Methods utilized a meta-analysis of case studies in the United States which have examined the rates of screening and diagnosis for children of low SES, how access to care may differ based on family income, and statistics/surveys on how treatment may be affected by this factor. This data is supplemented by a series of interviews with specialists from varying levels of exposure on the topic to gain an interdisciplinary perspective on children’s mental health care. It was discovered that variations in these demographics can cause significant changes in the barriers experienced for each individual. This signifies the necessity for unique and adaptable interventions instead of general response to ensure truly holistic care by taking into consideration how ethnicity, age, and SES can influence obstacles in receiving a diagnosis and eventually obtaining adequate treatment.

Understanding the Interaction of Symbiosis and Growth in the Temperate Coral *Astrangia poculata*

Grace Newsom

CAS, Biology - Ecology & Conservation

Advised by Dr. Randi Rotjan, Research Associate Professor of Biology, CAS

Coral reefs – backbones of coastal ocean biodiversity – are dying due to climate change impacts. *Astrangia poculata*, the Northern Star Coral, has a symbiosis with algae, which is not essential to its long-term survival. Whereas the opposite is true for most tropical reef corals. This symbiosis makes *A. poculata* uniquely resilient against changing climate conditions, and consequently makes it a great model organism to predict the worsening effects of climate change across coral species. Existing *A. poculata* research focuses on the coral's response to singular aspects of a changing climate (e.g., temperature extremes, plastic pollution, etc.), yet little research exists that supports a comprehensive understanding of how the coral lives and grows in the absence of those extreme stresses. To understand *A. poculata*'s basic biology more completely, this project exposes the coral to different combinations of light and food availability, and it investigates (1) how these conditions affect the coral's algal symbiosis, (2) how these conditions affect the coral's growth, and (3) how symbiosis acts as another factor to influence the coral's growth. Ultimately, light availability affected growth rate and symbiosis more than food availability, and symbiosis showed a more extreme response to the light than growth did. In lit conditions, the algal symbiont was an energetic benefit to coral's with access to food, and an energetic detriment to those without food. Further evaluation is needed to determine the degree to which symbiosis affects growth, but this work provides a step to solidifying *A. poculata* as an effective coral model.

Improving Post-Assault Treatment for Gender Diverse Survivors

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SAR, Health Science

Advised by Dr. Shannon Peters, Lecturer of Health Sciences, SAR

Transgender and gender diverse survivors experience gender-based violence (GBV), particularly sexual and domestic violence, at higher rates than their cisgender peers, and are at particular risk for negative impacts including suicidality, anxiety, and depression. Despite the urgency of intervention, GBV response resources are hard to come by and in high demand, often under-resourced as a result. The purpose of this study is twofold: to evaluate GBV response resources in their ability to foster inclusive services for gender diverse individuals, and to address the under-representation of gender diverse individuals in GBV research.

This study is an evaluation of the inclusivity of GBV resources in Massachusetts through a document analysis of their training and treatment resources. By highlighting the tenets of care deemed important, these documents can serve as a substitute for a comprehensive evaluation of the organization. The gender-inclusive content included in these training curricula illuminate explicitly how centers aim to treat their gender diverse patients.

While most centers devote at least a portion of their training to teaching providers and volunteers about gender diversity and how to talk to diverse patients, there is significant variety in the depth and breadth of these discussions. There are also discrepancies in how the trainings address gender, stereotypes, and best practices. The focus on gender diversity remains limited and is inconsistent in messaging, and to address this gap, I am providing improvement recommendations to be implemented at multiple levels in local response organizations.

Countering the Far-Right and Promoting Integration in Germany Through Public Messaging During the Syrian and Ukrainian Refugee Crises

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Advised by Ambassador Dr. Mark C. Storella, Professor of the Practice of Diplomacy, Pardee

In 2015, the European refugee crisis saw an influx of Syrian migrants into Germany, leading Chancellor Angela Merkel's administration to suspend the Common European Asylum System rules that required asylum-seekers to apply for asylum in the EU country they first entered. This decision set a new precedent in German history, but it was met with resistance from far-right groups, who mobilized anti-migrant and anti-refugee sentiments. My study examines the role of public diplomacy in shaping public opinion in Germany during this crisis, while addressing far-right narratives and integration.

The paper begins by exploring the historical role of migration in Germany and how this memory shapes public discourse. It then investigates existing literature on the amplification of far-right narratives and its impact on public attitudes towards refugees and asylum-seekers. The discussion then focuses on the German government's public diplomacy efforts, including its use of traditional media and emerging online platforms.

Through a critical analysis of the various tactics used by the far-right to define the public narrative, as well as an examination of the government's efforts to address the refugee crisis, this study sheds light on the complex and multifaceted nature of public diplomacy in Germany. The paper concludes that although Merkel's administration launched successful digital and print campaigns, the German government needs a cohesive digital approach for reaching younger audiences to effectively communicate the importance of forced displacement. The refugee crisis in Germany serves as an important case study for understanding the power of public diplomacy in shaping public opinion and policy.

The Edges of Freedom: Understanding Young Adult Conservative Beliefs about Queer Legislation

Jenna Riedl

CFA, Painting

Advised by Dr. Linda Maxwell, Professor of Political Science and Women's, Gender, & Sexuality Studies, CAS

While conservative politics push for reduced government control and freedom of expression, major conservative organizations demand that the government restrict queer expression. How do individuals reconcile these conflicting perspectives? Current political science research generally focuses on the intent of rhetoric from conservative politicians and news organizations rather than on whether individuals actually base their political decisions on media discourse. Through a series of interviews with young adult conservatives in the Boston area, this research explores their current beliefs on how the government should regulate queer people's expression in areas like healthcare, education, and marriage. The goal of this study is to open a dialogue with young adult conservatives in order to understand how their political beliefs and behaviors impact the queer community. To achieve true freedom of queer expression, we must know why people might be invested in denying that freedom.

The interviewed young adults generally demonstrated a high level of support for queer marriage rights, gender-neutral bathrooms and age-appropriate queer education within schools, which contradicts the dominant narrative about the conservative party platform. However, some interviewees expressed that, not being queer, they did not have an incentive to seek out information about queer legislation. Those who expressed hesitation about laws protecting queer freedoms argued that too much protection would make queer individuals unequal and dependent on the government. Those who supported laws that would restrict queer expression said that their motives were unrelated to the laws' effects on queer people. Having personal queer connections was crucial to interviewees' understandings of broad legislation and individual effects on queer people, demonstrating the potential of further dialogue between queer and conservative groups.

The Arctic on Fire: Mapping Change in High-Latitude North America

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CAS & GRS, Earth & Environmental Sciences and Remote Sensing & Geospatial Sciences

Advised by Dr. Mark Friedl, Professor of Earth and Environment, CAS

High-latitude Arctic and boreal ecosystems are tightly coupled to the global climate system, making them disproportionately vulnerable to the effects of climate change. Unfortunately, however, the remoteness and extent of these areas create challenges for studying large-scale ecological change. Satellite-based remote sensing circumvents many of these difficulties, providing valuable data for monitoring how anthropogenic and climate-driven forces are transforming Arctic and boreal ecosystems. The prevalence of shifting disturbance regimes (e.g., more frequent and intense wildfires) and large-scale land cover change make data on these topics especially vital.

In this project, I use satellite-based remote sensing and machine learning to classify land cover and detect ecological disturbances across a diverse range of landscapes in Arctic and boreal North America. Primarily, I assess the accuracy of land cover and disturbance products from the Center for Remote Sensing's NASA MEaSUREs initiative to quantify the performance of global modeling methods in the Arctic-boreal region. I then explore spatial and temporal trends in the data and compare modeled forest loss with high-quality wildfire maps to highlight one of the domain's most destructive and pervasive drivers of land cover change. The results of this project demonstrate the importance of satellite-based remote sensing in high-latitude research and support a better understanding of the impacts of global climate change on high-latitude ecosystems.

Filtering Speckleplethysmographic (SPG) waveforms to determine brain activation-induced blood flow

Matthew Leal

ENG, Biomedical Engineering

*Advised by Dr. David Boas, Professor of Biomedical Engineering,
ENG*

Photoplethysmography (PPG), an optical imaging method utilizing LED light and photodiodes to detect light absorption, can be used to measure volumetric changes in the blood generated by cardiac contractions. On the other hand, speckle plethysmography (SPG) is a relatively new imaging method that produces similar results as PPG using laser speckle imaging to analyze blood flow rate changes with a higher signal to noise ratio. While PPG and SPG signals together can give a more holistic view of vascular physiology, there is a lack of understanding on the spatiotemporal relationship between them. The goal of this project is to process raw SPG and PPG data with aims of removing unwanted noise and averaging the pulse waveforms to analyze their components, with a focus on cerebral hemodynamics specifically because this imaging method is suitable for a superficial region of interest (i.e., skin, brain, retina). The project was able to successfully remove cardiac induced blood flow, so that what was left included only blood flow induced by brain activation. This was done by finding the onset of each heartbeat, constructing an average heartbeat, and subtracting this from the raw SPG data along with other unwanted components found using singular value decomposition methods in order to view only brain activation-induced blood flow. In future work, the ability to study brain activation-induced blood flow in the brain using SPG could be used to study hemodynamic responses to different stimuli in order to increase our understanding of cortical functions.

Examining the Market Reaction to Mandated Climate-Related Disclosures

Rebecca Sarkisian

QST, Business Administration & Management (Accounting & Finance)

Advised by Dr. Eddie Riedl, John F. Smith Jr. Professor of Management, Professor of Accounting, QST

On March 21, 2022, the U.S. Securities and Exchange Commission (SEC) proposed a rule requiring public companies to include climate-related disclosures within financial statement filings. In particular, companies would be required to disclose greenhouse gas emissions generated at any point along the company's value chain, even if the company is not directly responsible, as well as additional information, including the climate-related risks the firm faces and the firm's risk mitigation strategy. The placement of climate-related disclosures in the financial statements signals the importance of climate change to investors and the future of business.

My project explores three aspects of these proposed mandated climate disclosures. (i) I assess the proposed rules to establish the disclosure requirements, and how they may vary by firm. (ii) I examine the comment letters filed with the SEC, documenting support and opposition. (iii) Most importantly, I quantitatively assess the stock price reaction to the proposed regulation. Changes in stock prices in reaction to this announcement reflect investors' revised expectations of its costs and benefits. Using data from over four thousand U.S. publicly-traded companies, I find a significant decrease in stock prices in the two days following the announcement, after adjusting for normal fluctuations. This decrease is more pronounced for larger companies and those having higher levels of debt. The negative stock reaction suggests that investors may view companies' current climate-related disclosures as inadequate, and expect higher costs in the future as a result of the regulation, such as increased regulatory scrutiny regarding climate-related risks and emissions.

A New Theory: Rape Myth Acceptance in Everyday Language & Unacknowledged Rape*

Marie Kimball

CAS, International Relations & Spanish

*Advised by Dr. Lynn O'Brien Hallstein, Professor of Rhetoric, CGS;
Dr. Kirsten Greenidge, Associate Professor, CFA*

According to data from the Rape, Abuse & Incest National Network (RAINN) and Statista, approximately 28.2 million women in the United States have survived an attempted or completed rape. Everyday language surrounding rape often contains not only rape myths, or misconceptions about rape, but also an acceptance of these misconceptions, referred to as Rape Myth Acceptance (RMA). These regular, mundane conversations accept and perpetuate falsehoods about rape in real and virtual spaces and shape how people understand and even define rape.

In order to better understand the dynamics of RMA, I conducted a wide-ranging textual review of primary and secondary sources including social media posts, memoirs, news articles, magazines, scholarly articles, podcasts, and books. I then drew broader conclusions from correlations that previous scholarly articles had established and from my own observations of the data. My findings reveal a new theory as follows: Rape myths, which are abundant and accepted in everyday language and conversations contribute to the societal maintenance of ill-informed beliefs about and even definitions of rape. This has implications for continued widespread unacknowledged rape, or the inability to identify what has occurred as rape, among survivors of rape, which may impair healing and justice.

Based on these findings, I have written a report and a theatrical script, each of which explicitly provides insights into the pernicious nature of RMA within everyday language. Further clarity regarding RMA within everyday language may reduce unacknowledged rape and improve the possibilities and processes for both recovery and prevention.

**Content Warning: Mentions of Rape and Sexual Assault*

No Oblivion: Our Lost Years?

Erica MacDonald

CAS & COM, International Relations & Journalism

Advised by Dr. Anna Henchman, Associate Professor of English, CAS

No Oblivion: Our Lost Years? is an exercise in generational narrative journalism. It aims to convey the collective story of young adults coming of age during the pandemic. I've selected personal vignettes that take place at moments of great change or document impactful experiences. These moments are inexplicably part of how we remember this time; they are the outline of years in the rearview.

Montreal. Opening my phone during a spring break trip in 2020. Having to tell my friends we would not be going back to school.

Boston. Eating dining hall take-out in sterile plastic boxes, sitting six feet apart in the 2021 winter snow.

London. Standing in a British public affairs office in 2022, watching bombs descend on Ukraine. The geopolitics of my internship suddenly overlapping with my heritage.

No Oblivion: Our Lost Years? has been shaped by long-form journalistic features and inspired by Alfred Tennyson's century-defining collection of poems *In Memoriam, A.H.H.* (1850). The intent of the keystone is recording and reflecting during an emotionally and politically charged time. Its deliverables are equally distributed across its process, form, and final product of creative nonfiction. No Oblivion testifies to enduring jarring shifts and regaining one's balance as the look and feel of the world changes before our eyes. It attempts to grasp how the past, present, and future inform each other—to practice historical consciousness in real time.

Health At Every Size Model for Clinical Practice

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CAS, Biology

Advised by Dr. Sophie Godley, Clinical Associate Professor of Public Health, SPH

Weight stigmatization by clinical healthcare providers creates a barrier to healthcare and can mean a later detection of illness, and therefore a higher likelihood of a patient having serious medical problems in the future. Weight stigmatization therefore directly affects the physical health of patients of all sizes. While the existence of weight stigmatization in clinical healthcare providers is well documented in existing research, possible ways for clinical healthcare providers to decrease weight stigmatization are less covered. My study used qualitative case study interviews of clinical healthcare providers (n=5) (ranging from physicians' assistants, medical assistants, nurse practitioners, and doctors) in the Boston area to consolidate strategies that healthcare providers have implemented towards promoting Health at Every Size (HAES) friendly clinical practice. The idea of HAES friendly clinical practice is a preexisting framework that encompasses healthcare practices which affirm a holistic definition of health, reject the idealizing or pathologizing of specific weights, and acknowledge weight biases while working to end weight discrimination and the creation of weight stigmatization. Following confirmation that subjects agreed with this framework, I asked healthcare providers questions surrounding how they treat weight and health, how they interact with patients around weight, and what ideas they have for making practices more HAES friendly. The results of this study will compare commonalities between healthcare providers' attitudes around health and weight and examine common approaches they implement or want to implement to decrease weight stigmatization.

PED Use for Professional Athletes: Is it Actually Profitable?

Jared Klinkowize

QST, Accounting

Advised by Dr. Greg Stoller, Senior Lecturer of Strategy & Innovation, QST

The use of performance-enhancing drugs (PEDs) exploded in the world of pro sports during the 1990s, dubbed Major League Baseball's "Steroid Era." Since then, athletes have been suspended and stripped of their sporting achievements when caught using PEDs. Given the drastic consequences of being caught, there must be a reason that pro players willingly use steroids.

Most published academic and research studies focus on the shameful immorality of steroids, and how cheating has decimated the world of sports. My project takes a different tact, asking if taking steroids is actually profitable. Money is a key motivation for athletes choosing to use steroids. Athletes compete for multi-million-dollar contracts and endorsements and will do anything to stay ahead. Studies that ignore the financial incentive miss a key element of the equation. I considered the relative revenues and costs of taking steroids to perform a financial analysis and found that they increase earnings, earnings potential, and overall profitability for professional athletes.

CAMP: Challenges for Autistic Middle-Schoolers Post-Pandemic

Izabella Rogers

SAR, Human Physiology

Advised by Dr. Helen Tager-Flusberg, Professor of Psychological & Brain Sciences, CAS

The COVID-19 pandemic forced many students to adapt to online learning. While prior studies have focused primarily on students with autism during the period of remote learning, less is known about the period following remote learning. Therefore, this study explored the challenges that students with autism faced upon returning to in-person learning. Parents of children with autism, aged 12-16, completed a demographics survey, the Social Responsiveness Scale (SRS), and the Parent-Rated Anxiety Scale (PRAS-ASD). Parents also completed interviews over Zoom, during which they were asked questions about remote learning, morning routine, sleeping and eating habits, academic performance, and anxiety. Qualitative content analysis was performed on transcribed interviews, and associations among variables were explored using correlation analyses.

Results showed that all children scored high on the SRS, indicating severe autism symptoms. However, the PRAS-ASD scores were evenly distributed. Children with lower verbal ability had more trouble focusing during online classes. In addition, children with higher SRS scores had a more diverse diet upon returning to school. While changes in academic performance varied across children, nearly every parent reported that their child received less support and experienced more anxiety upon returning to school. Social anxiety in particular was associated with a disruption of morning routine, as well as a change in sleeping habits. Further research is needed to determine what strategies can be implemented to minimize anxiety in students with autism and to ensure that they are able to succeed in their studies.

Designing Impactful Aid Programs for Smallholder Coffee Farmers

Sara Strassel

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Every year, we consume over 400 billion cups of coffee worldwide. Coffee is incredibly susceptible to environmental changes; the increasingly unpredictable climate threatens crop losses that devastate the coffee supply chain. Millions of smallholder farmers face an array of challenges to earning a livable income. Small producers can't respond well to market downturns as they are unable to diversify their crops due to high initial investments. The International Coffee Organization estimates that 12% of the average supermarket price and less than 3% of the price of retail brewed coffee is paid to the producer. Coffee farmers, especially smallholder farmers, need interventions that boost their crop yield, profit margins, or both.

My project focuses on the importance of hearing and prioritizing farmers' needs during the design process for aid programs. While many aid programs for farmers already exist, there lacks an industry-wide standard for what marks an impactful program. Through a review of literature on the coffee industry, existing aid programs, and aspirations vocalized by farmers, I identified criteria to be used in evaluating support programs through an evaluation rubric. These criteria, which include financial sustainability, community involvement, and long-term impact, reflect the needs voiced by coffee farmers, not just the assumptions of profit-driven corporations. Without the valuable input from farmers, programs often miss the mark in meeting the needs expressed by coffee-farming communities. When companies are held responsible for how they assist farmers who drive their profits, they create a better product for consumers and a better life for farmers.

Augmented Reality Climbing Wall

Ryan Smith

ENG, Computer Engineering

Advised by Dr. Kenneth Sebesta, Assistant Professor of Mechanical Engineering, ENG

Our project focuses on optimizing the current augmented reality climbing walls by creating a smoother, mistake-free gaming experience for the user. To accomplish this, we plan to take the skeletal tracking system that most augmented reality climbing walls already use and couple it with our own active sensors that would be attached to the climbing holds already on the wall. Doing this would remove the reliance on the inconsistent skeletal tracking system and add a second element that can actively sense which climbing holds the user is exerting pressure on while hanging from the wall. In addition to providing users a smoother experience, we also plan to develop our own augmented reality climbing wall games such as Simon, a pattern matching game, that the user will be able to enjoy without error or delays while on the wall.

Updraft Tower Power Generation In Existing Industrial Structures

Jacqueline Bachrach

ENG, Mechanical & Aerospace Engineering

Advised by Dr. Francis DiBella, Senior Lecturer of Mechanical Engineering, ENG

An Updraft Tower is an energy generation system which amplifies an existing energy source. It intakes air, heats it using a fossil fuel or renewable source, and utilizes thermodynamic properties to power a turbine. This generates a much larger amount of power than the initial source could alone. The energy increasing ability of Updraft Towers allows for the large-scale reduction of pollution and mitigation of climate change but traditional tower designs face many construction, financial, and environmental challenges. Addressing the issues of traditional Updraft Towers, this project aims to adapt the technology by utilizing existing structures and the exhaust from manufacturing processes. In many industries, processes used in manufacturing of goods create heated air as a byproduct and factories frequently release this air through tower-like structures called smokestacks. This project aims to prove the viability of converting ordinary, exhaust producing smokestacks into Updraft Tower systems. An extensive research phase was conducted, and properties of potential industry collaborators were analyzed. This culminated in a MATLAB model which is capable of predicting the power output of a hypothetical smokestack power system. A scale model of an industrial Updraft Tower was constructed and was able to generate substantial power, proving the viability of the concept. Finally, a full proposal with specific instructions on how to convert a smokestack into a fully functional Updraft Tower was written. This proposal contains information about construction, energy savings, monetary advantages, and environmental impact of conversion, as evidenced by research and experimentation, for an audience of industrial manufacturers.

Investigating the Target Protein - DNA2 - in the Cytosolic Iron Sulfur Cluster Assembly (CIA) Pathway

Max Brown

CAS & GRS, Biochemistry and Molecular Biology & Biotechnology

Advised by Dr. Deborah Perlstein, Associate Professor of Chemistry, CAS

The Cytosolic Iron Sulfur Cluster Assembly (CIA) Pathway is an essential and conserved pathway in all cells. This pathway is the basis of the synthesis of iron sulfur clusters which are widely important cofactors in a variety of processes ranging from DNA replication to metabolic processes in the body and the cell. However, there are many gaps in the understanding of this pathway which must be understood in order to propose possible drug targets for curing metabolic diseases and DNA-related cancers in humans. I am currently working on elucidating the CIA pathway further by studying the apo-protein DNA2.

In order to understand how the CIA pathway adds iron sulfur clusters to proteins, I need to purify the DNA2 protein, which is an essential protein in DNA transcription, translation, replication, and recombination. DNA2 is a target in the CIA pathway as it requires an iron sulfur cluster cofactor in order to function. Many experiments have been performed to isolate this protein to further understand the CIA pathway, but they have previously failed. This protein is unique in that traditional purification methods do not work, so for my project, I have tested new purification methods. The successful methods I have found are: IPTG induced cell growth, Ni-NTA affinity chromatography, finally followed by cation exchange chromatography. Now that DNA2 is purified, future experiments can be conducted to understand the targeting mechanisms within the CIA pathway and ultimately drug targets can be proposed and tested. In conclusion, pure DNA2 is the key to further understanding the novel CIA pathway, and with its heavy association with DNA, it will be a useful protein for studies depending on carcinogenic DNA mutations.

Judging a Book by its Ink: A Historical Perspective on the Perception of Tattoos within the United States

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Wheelock, Early Childhood Education

Advised by Dr. Zachary Rossetti, Associate Professor of Special Education, Wheelock

What do tattoos mean within the modern United States? Where did they come from?

Do tattoos automatically make others perceive you as a degenerate? A part of the working-class? A delinquent? A gang member, a rebel, or dangerous?

Do tattoos make you cool? Enticing? Unique? A walking piece of art? Rich?

Do tattoos mean nothing more than some ink in the skin? An added piece of jewelry, if you will.

Historically, tattoos within the United States were for rebels and subcultures, originally existing thanks to traveling sailors being exposed to indigenous tattooing practices. While at first a spectacle, garnering the attention of thousands at traveling circuses and sideshows, tattoos later became associated with working-class culture and were predominantly located in areas characterized by poverty and crime. However, ever since the 1960s with the so-called “tattoo renaissance,” the class and gender boundaries of tattooing have blurred, and it has become a means of communicating personal identity.

As tattoos become more prevalent within the United States, will they ever truly be accepted? Or will it always have a subversive element that is seen as “unprofessional?”

Come with me and explore the varying perspectives on tattoos and their surrounding culture!

College & COVID-19: Perceived Changes in Cognitive Function and Mental Health

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CAS, Behavioral Biology & Psychology

Advised by Dr. Alice Cronin-Golomb, Professor of Psychological and Brain Sciences, CAS

COVID-19 is an infectious disease that has been heavily researched in terms of its more immediate, acute physical symptoms. Long-term cognitive and behavioral health issues have also been demonstrated, especially in young adult populations, but are less understood. My keystone project examined whether personal perceptions & lifestyle changes surrounding the pandemic have contributed to any enduring changes in a student's cognition and mental health. Thanks to responses from nearly 500 BU students during a time where all COVID-19 regulations were lifted on campus since the initial pandemic outbreak, associations were examined between student demographics, cognitive and mental health characteristics, quality of life and well-being, as well as COVID-19-related experiences. While there were no differences in cognitive or mental health parameters based on personal infection status, there was found to be a positive correlation between executive dysfunction, sleep dysregulation, and mood disorders with overall COVID-19 impact. Although infection presence increased the severity of this impact, cognitive and behavioral impairments were broadly displayed only when accompanied by long-term symptoms. More consideration should be placed upon the pandemic's impact on students' overall quality of life rather than solely on positive test presence. Infection does not seem as definitive as initially thought in cognitive-behavioral decline accompanying post-lockdown conditions. As college students are already a vulnerable population for mental health and learning issues, more awareness on any residual effects the pandemic may have on those who were and were not infected will be vital in mitigating these exacerbating circumstances.

Autonomous Sorting, Inspecting, Orienting, & Stacking Assembly for Industrial Manufacturing at Senior Metal Bellows: “The Diaphragmatic 9000”

Sanjana Ahmed

ENG, Mechanical Engineering

Advised by Dr. Stephen Chomyszak, Professor of the Practice, ENG

The engineering problem faced by Senior Metal Bellows (SMB) is the downtime incurred during the manual sorting, orienting, inspecting, and stacking of thin metal diaphragms. The diaphragms are 0.6” in diameter and welded together to form bellows, which are flexible spring-like vessels that expand/contract and are used for cushioning in vehicle engine housing—or for tubular transport of gasses in fuel-powered devices and pneumatic actuation. In SMB’s current production line, diaphragms are ejected in random orientations, 1 per second, from a stamping press. To improve cycle time, efficiency, and part quality, SMB is seeking automation to sort, orient, inspect, and stack parts with lower latency, error, and wasted operator skill.

Five students collaborated to build a tabletop electromechanical system to accomplish these tasks. We first designed a sorter to distinguish diaphragms by concavity, make all parts face one direction, and combine them into one channel. We transported parts to visually inspect both faces for flaws using two continuous conveyor belts, a flipping mechanism, and two cameras equipped with defect detection software. The sorter, flipper, and stacker are 3D-printable and use gravity to move parts along our assembly; we also programmed electronic controllers for inspection, motorized motion, and part rejection. Pneumatic components are connected to digital outputs so that two nozzles, one aimed at each belt, can use compressed air to blow bad parts off the belts after receiving failed-part signals from the vision system. Remaining good parts are stacked onto a fixed rod at the outlet. We are now testing the repeatability, reliability, and precision of our completed assembly while evaluating its technical feasibility, implementability, and economic justification to replace the current process.

Saving Energy in Vertical Farms with Autonomous Harvesting

Scott Wade

ENG, Mechanical Engineering

Advised by Dr. Anthony Linn, Professor of the Practice, ENG

My team is creating a new architecture for vertical farms. Vertical farming is a relatively new farming method which consumes less water than traditional methods. In contemporary systems, dedicated areas in a facility are used for seeding, growing, and harvesting crops. Since these are done in different locations, flats of plants and growing substrate are transported around a warehouse, which consumes significant energy for conveyance. These conveyance costs prevent higher-value plants that must be regularly harvested, such as fruits and nuts, from being grown in vertical systems. Our team hopes to bridge this gap. We have designed an architecture which will enable the economical harvest of fruit from within the growing racks of a vertical farm and have developed a prototype of a robotic system to harvest fruits from a model farm. Through this work, we pose an improved model for vertical farm architecture, informing future water-efficient agriculture.

Terrier Motorsport Aerodynamic Package Manufacturing Strategy

Jared Pratt

ENG, Mechanical & Manufacturing Engineering

Advised by Dr. Anthony Linn, Professor of the Practice, ENG

Terrier Motorsports, Boston University's electric formula team, designs a new electric race vehicle regularly which will have aerodynamics packages to improve racing performance. Current methods for manufacturing aerodynamic components are inefficient, unsafe, and costly and as a result, Terrier Motorsport has asked for help improving current practices and creating new procedures. Investigation into current practices and part designs was conducted to get a better grasp of the problem at hand. Research in areas such as experimental aircraft designs and boat hull manufacturing were conducted in order to find guidance on how to improve and create methods for Terrier Motorsports. Test procedures were conducted to find out what methods work and what methods could be improved upon, and the resulting test coupons were exposed to various tests to determine the quality of manufacturing. From this semester's progress, the team was able to find which procedures and methods show enough promise in order to further develop and optimize those chosen methods next semester. From this project, the team has been able to analyze the manufacturability of designs, apply industry techniques to Boston University scale facilities, and get exposure to a small-scale supply chain. With this semester's progress and next semester's plans, the team will be able to deliver physical aerodynamic components along with standard operating procedures, quality inspection guidelines, and supply guidelines for future Terrier Motorsport teams.

Studying Muscle Development in Tadpoles Expressing Mutations for a Rare Neurodevelopmental Disorder

Lydia Bischoff

CAS, Cellular Biology, Molecular Biology, & Genetics

Advised by Dr. Isabel Dominguez, Assistant Professor of Medicine, BUSM

Tadpoles and frogs are emerging model organisms in neurodevelopmental disease and are solid models used to make many discoveries in biomedical research. Because tadpoles have made biomedical research more efficient, I used tadpoles as a model organism to study muscle development in a rare disorder called Okur-Chung Neurodevelopmental Syndrome (OCNDS). One of the many symptoms of OCNDS includes difficulties with chewing and swallowing, which is thought to stem from defects in muscle development. To learn more about the mechanisms of OCNDS, I ran a pilot experiment to test if the expression of OCNDS mutant proteins leads to defects in facial muscle development. For this, I used immunofluorescence to stain two muscle groups that are related to jaw movement in tadpoles, the orbitohyoideus and the quadratohyoangularis. I then quantified the intensities of the staining to determine differences in muscle development. Based on the tadpoles we have stained currently, the results indicate that there is a difference in staining intensities between mutant-expressing tadpoles and control tadpoles for the orbitohyoideus, but not for the quadratohyoangularis. These results indicate that OCNDS mutant proteins can affect muscle development in specific cranial muscle groups.

Additionally, I have created a small booklet to explain how frogs and tadpoles have been used in biomedical and OCNDS research. By providing more information to patient caregivers and studying OCNDS in model organisms, we will make advancements toward finding a cure for OCNDS.

Immersive Learning at the Border: Development and Assessment of the Border Studies Program with BU's Center on Forced Displacement

Baiden Wright

Pardee, International Relations

Advised by Dr. Carrie Preston, Professor of English and Women's Gender, & Sexuality Studies, CAS & Founding Co-Director, Initiative on Forced Displacement

Migration across the US-Mexico border is a complex and pressing social imperative that calls for attention in academic institutions. This project takes a four-pronged approach in engaging US-Mexico border dynamics in academia and student-centered spaces, each of which involves a different pedagogical approach. The first approach centers around the development and implementation of an academic course curriculum, which guides students through a carefully plotted series of readings and videos. This approach creates a strong baseline understanding of the varied dimensions that constitute the crisis at the border. With this foundation, students are better able to transition into the project's second prong: an in-person immersive learning experience conducted in Texas borderlands. On-site programming not only encourages a thorough, personal, and multidimensional understanding of US-Mexico migration dynamics, but empowers students through in-person involvement with a variety of cross-sector collaborations. The more nuanced understanding attained through travel to the border informs the third prong, student project development, through which students can more precisely focus their engagement with the issue and develop marketable skills and knowledge sets. Finally, the project employs an ongoing assessment and interview process to solicit feedback and refine the course with the potential for expansion into other global contexts. The presentation of this project takes a semi-autobiographical form, with the author sharing their own experiences on both the development side as well as the educational side of the course.

Looking Back: The Link Between the Partition of 1947 and the Citizenship Amendment Act of 2019

Akshata Shukla

CAS, Cellular Biology, Molecular Biology, & Genetics

Advised by Dr. Amanda Fish, Postdoctoral Associate, KHC

The 1947 Partition of India sent shockwaves throughout South Asia and triggered one of the largest human migrations in modern history. Millions of displaced people were forced to abandon the lives they had known and reorient themselves according to religion, as Hindus headed east into a receded India and Muslims headed west into a newly created Pakistan. The crude redrawing of borders by the British Raj before its retreat out of India has been largely regarded as an inevitable occurrence—the sole solution to what has been portrayed as inherent religious discord between Hindus and Muslims. This view of Partition is narrow and incomplete, failing to account for the intricate political play between political parties that catalyzed the ultimate split, and the mass violence that followed it. In 2019, the Bharatiya Janata Party (BJP), India's ruling right-wing party blurred the lines of secularism that define the country's constitution by passing the Citizenship Amendment Act. The law gave Indian citizenship to illegal immigrants on the basis of religion, notably excluding Muslims. This blatant move of religious discrimination was one of many in a series of similarly oppressive acts, leading to increased animosity directed towards India's Muslims. It is essential to look back at Partition in its entirety—the driving political forces behind it, the rushed British withdrawal following centuries of colonialism, and the sheer violence left in its wake, much of it gendered and targeted—to understand modern day India and the continuous conflict between Hindus and Muslims.

AWCUA (Autonomous Water Condition Understanding Apparatus)

Cathy Cheng

ENG, Mechanical Engineering & Biology

Advised by Dr. Frank DiBella, Senior Lecturer of Mechanical Engineering, ENG

Despite the fact that it is used by over 1 million people annually, the Charles River contains significant chemical contamination. Based on current data, there is a significant threat from harmful algal blooms (HABs) and bacteria in the river. There is a deficiency in cost-effective, continuous monitoring techniques for HABs and bacteria, which is required in order to recommend action for remediation as well as to monitor intervention methods. The intention of this project is to monitor the HABs and bacteria in the Charles.

Current data and technologies suggest a gap in cost-effective solutions, where existing methods involve using laboratory techniques, satellite imaging, or UV-VIS spectrometry. In recognizing the importance of having widely available and cost-effective methods for water quality monitoring, this project uses concepts from UV-VIS spectrometry to develop a compact sensor for detecting particular strains of cyanobacteria and E. coli.

The project is broken up into two main components: the sensor and the docking station. The sensor device is composed of a circuit that uses a timing system on the several lights attached to send photons into the sample, whose transmitted light is collected using a photodiode. Optical sensors work on the principles of spectrometry, where the wavelength properties of samples are used to identify the compound. The docking station is a structure designed to hold multiple sensors as well as relay, store, and display data.

Thus far, the project has demonstrated the potential to achieve the same outcomes as currently available sensors at a fraction of the cost.

Quantifying Bias Across Digital Media Platforms

Ruby Price

CAS, Computer Science & Linguistics

Advised by Dr. Derry Wijaya, Assistant Professor of Computer Science, CAS

The study of implicit bias in digital media is a subject of increasing inquiry in computational linguistics. The detrimental effects of implicit bias in professional areas like healthcare and education are clearly studied, but the continuing significance of online media platforms has made the ability to detect and understand digital bias vital. However, digital mediums can have vastly different formality and user behavior, so examining implicit bias across multiple environments is necessary in characterizing online bias. To investigate this, I studied both news media articles and Twitter data to examine racial and gender bias, respectively. The metric of bias for the news media was the toxicity score of a person's mention in the article, which was measured using a pre-trained classification model detecting profanity, negative sentiment, and other text attributes. Although more research is needed to detect a clear trend of bias, the news media data demonstrated that toxicity in discussing different races depended on the general sentence topic. Bias in the Twitter data was measured by training a word embedding model on tweets from men and women, and seeing if the vector representation of keywords (i.e. "female" or "immigrant") were more similar to a positive or negative keyword (i.e. "bad" vs "good"). I found that although women and men do display different semantic usage of certain keywords, the chosen positive and negative comparators are a larger predictor. For example, women were more likely to align a term with the "good" keyword, but also the "hate" keyword, than men. This context-dependent analysis can thus help identify more nuanced expressions of bias within a chosen demographic.

Framing Transition Care for Obesity Management Through Holistic Approaches

Nadira Harshitha Sivabalan

CAS & SPH, Biology & Psychology & Public Health

Advised by Dr. Eric Nolen-Doerr, Assistant Professor of Endocrinology, Diabetes, Nutrition, & Weight Management, BUSM

The high obesity prevalence in adolescents between 12-19 years of age puts them at massive risk of having obesity as adults and developing other life-threatening conditions. The US healthcare system spends over 147\$ billion dollars every year on obesity treatment. Yet, successful and sustained obesity management continues to elude healthcare providers and patients alike. Adolescent obesity requires continuous and comprehensive care that addresses their needs as an adolescent and the changes they experience as they transition into adulthood. There is no existing framework or insight into what obesity care looks like for a young adult. Care is complicated by differing negative attitudes from the community towards obesity and internal weight biases. Therefore, we need to create a care plan that provides a scaffolding for obesity management from the late teenage years into adulthood that is holistic and cognizant of how these attitudes affect obesity care and management. By analyzing the existing literature, this paper provides an analysis of how we would apply the psychological and social benefits of a holistic approach to obesity in the context of the transition of care from adolescence to adulthood. This paper presents basic suggestions for the factors that need to be considered in creating clinical guidelines for proper care.

Sexism and the Treatment of Women in the Online Chess Community

Lauren Byerly

CAS, Political Science & Women's, Gender, & Sexuality Studies

Advised by Dr. Sarah Miller, Lecturer of Sociology, CAS

This project analyzes how the online chess community has perpetuated sexist attitudes about women in chess. Many women describe experiencing sexism in the chess community, yet little research has been done to respond to this issue. In this project, I address the following questions: “How are women treated in the chess world? How do sexist attitudes affect the way that women’s chess performance is discussed? How does the structure of chess competitions affect how women are treated and perceived in chess?”

To conduct this study, I engaged feminist approaches to research to analyze women’s experiences in chess communities. I compared current findings on the sexism in the chess community to my observations of online discussion and representation of women chess players. Specifically, I considered incidents where women allegedly cheated, the reasoning or lack thereof for gendered chess titles, and the comments left by online audiences about women. I find that biased cheating allegations have been lodged against women, women chess players have been sexualized by their audiences, and The Queen’s Gambit encouraged women to play chess.

The chess community needs to become a more welcoming space for everyone. I argue that gendered chess titles should be discontinued, better systems should be set up to address gender bias in competition, and more women and gender diverse people should be encouraged to play chess through scholarships, media representation, and community organizations.

Increasing speed of electric racecar by independently controlling rear wheels

Giacomo Coraluppi, William Krska, Nicholas Marchuk, Yonathan Ye, & Alexander Zhou

ENG, Electrical & Computer Engineering

Advised by Dr. Alan Pisano, Associate Professor of the Practice (ECE), ENG; Dr. Osama Alshaykh, Assistant Research Professor, ENG

As motorsports categories are turning towards electric vehicles, teams are developing new strategies to reduce lap times. By independently powering each of the rear wheels rather than giving the same power to both, we can increase cornering speed and the driver's feeling of control as the car will be less likely to drift. This project will help the BU motorsports team gain a competitive advantage over their opponents. We created a mathematical model to estimate the car's momentum and traction at each wheel given steering and throttle inputs from the driver, as well as the car's current speed. We use these values to calculate the left and right motor signals, which determine how much power will go to each wheel to balance the vehicle and take the corner at a faster speed. The product includes a fail-safe system to shut off power to the wheels in case of any mechanical or electrical failure to ensure driver safety.

The Madison Method: Creating Accessibility & Customizability in Dance

Madison Sofield

CAS & QST, Psychology & Innovation and Entrepreneurship

Advised by Dr. Peter Marton, Senior Lecturer of Strategy and Entrepreneurship, QST

The Madison Method is a creative business project that aims to create a bridge between dance studios and dance consumers, with a specific focus on parents of young dancers. The objective of the project is to identify the specific qualifications that consumers are looking for when choosing a dance studio and to make dance more accessible in terms of cost, location, and other important factors. By creating a platform that connects consumers with affordable and practical dance studios, the project aims to increase the number of young dancers who have access to quality dance education.

To achieve its goal, the project utilized the 9 canvas business model, which includes various sections such as customer segments, value propositions, revenue streams, channels, key resources, key activities, key partnerships, cost structure, and the overall value chain. The final product of the project is an expanded business model presented in the form of a pitch deck.

In conclusion, the “Madison Method’s” goal is to create a sustainable business model that benefits both dance studios and consumers. The project's focus on specific qualifications and accessibility will help institute a supportive dance community that encourages young dancers to pursue their passion for dance without unnecessary strain on their families.

Surveying Machine Learning Techniques for Brain-to-text Handwriting Communication

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CAS, Psychology & Computer Science

Advised by Dr. Sang (Peter) Chin, Adjunct Professor of Computer Science, CAS

The field of Brain-Computer Interfacing (BCI) has flourished with the help of machine learning for the classification and prediction of neural activity. A prevailing theory in modern neuroscience posits that neurons should be viewed as correlational structures or systems in order to understand how they interact to represent ideas and actions.

Following this perspective, my research assesses the aptitude of artificial neural networks (ANNs) designed to handle datasets representing complex systems for use classifying neuronal activity data in the motor cortex.

Using data from a recently published study on the motor cortex activity of a paralyzed subject imagining handwriting English characters, ANNs designed to process images, image sequences, graphs, and high-dimensional graphs called simplicial complexes were each trained to classify a given snippet of neural activity with the English character the subject was writing during recording.

Preliminary findings indicate that neural networks trained on graphs and simplicial complexes do not necessarily produce higher classification accuracy even though they capture significantly more correlational relationships between neurons than those trained on images or image sequences. ANNs trained on image sequences have performed the best at this stage, indicating that how the neurons behave over time and their physical proximity to one another are central features to character classification.

A Tale of Two Lobbies: Interest Group Influence & the US-Vietnam Rapprochement Process

Sydney Steger

CAS & Pardee, International Relations

Advised by Jeremy Menchik, Associate Professor of International Relations, CAS

In a major shift from previous presidential administrations, the Clinton administration was proactive in their efforts to succeed in the U.S.-Vietnam rapprochement process. While this change may be explained by geopolitical trends, such as the decline of the Soviet Union and economic reforms in Vietnam, this doesn't capture the role of larger American civil society and individuals in the normalization process. This article seeks to address why this shift occurred and understand the ambitions, tactics, and changing influence of relevant lobbying groups. Two interest groups, the POW/MIA lobby, and the American business community were prevalent in the conversation around normalization. Through original archival research performed at the Clinton Presidential Library, this article investigates how these groups and their strategies shaped the Clinton administration's push towards normalization. This perspective helps us understand the micro-level interactions that informed this larger, significant American foreign policy decision, and thus better understand the roles that individuals and civil society play in contemporary American foreign policy formation. Additionally, we can better understand a key but overshadowed moment in the increasingly important U.S.-Vietnam relationship.

The State of North American Carbon Markets

Yash Patel

QST, Business Administration

*Advised by Dr. Petro Lisowsky, Associate Professor of Accounting,
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With strong private sector participation, government implementation, and NGO support, carbon markets are poised for explosive growth bringing greater quantifiable emissions reductions and investments into climate projects. Whether you participate in the voluntary or compliance markets, the landscape is ever-changing with increased regulation and greater returns for investors. Although this form of exponential growth poses a variety of new opportunities, it also introduces countless new problems—the scaling of carbon markets cannot be done at the sacrifice of quality and integrity, or they will do more harm than good.

This study explores the costs, returns, correlations, and efficiencies of major carbon markets such as the California Carbon Cap and Trade Market, the Regional Greenhouse Gas Initiative, and the newly implemented Washington Carbon Cap and Invest Allowances Market.

This study also investigates the decentralized approach taken by the US, tasking each state with designing individual carbon markets. California has emerged as a leader in Carbon Markets, on track to reduce its 2023 emissions by 16-18% with an original target of 11.25%. As other states attempt to follow, it is becoming increasingly difficult to merge markets as each state has its own agenda.

In such a rapidly developing and dynamic industry, this study explores the present and future of Carbon Markets in North America.

Rocket Engine Fuel Pump

Nicholas Mangold

ENG, Mechanical Engineering

Advised by Dr. Anthony Linn, Professor of the Practice, ENG

This mechanical engineering design project studies the feasibility of building a small-scale electric-driven fuel pump for use in smaller scale space applications, primarily for use in orbital rockets. While centrifugal fuel pumps are a mature field of study, their uses are primarily used for ground applications, where optimization for size and weight isn't a primary concern. Custom designed aerospace grade pumps are locked behind high paywalls, and such systems are typically built for specific vehicles. The analysis and design presented in this team-effort project seeks to develop a prototype liquid isopropyl alcohol fuel-side pump, around flight conditions set forth by the Boston University Rocket Propulsion Group, representing common flight conditions for affordable-scale rockets. For safer testing in a lab setting, a scale model will be used, that has different specifications from the initial project scope, and final specifications of a functional pump system, yet has similar performance at a different size-scale. A computational MATLAB code was written that allowed the team to determine the proper scale model factors for the pump based on a change of working fluid to water and a lower RPM. Using the results of that analysis, a super scale model was able to be designed, in addition to providing the necessary information allowing for the design of both a supporting fluid fuel flow, and electrical system. A prototype of the entire fuel pump system was constructed in the actual-scale, rigorously designed for assembly according to engineering best practices, and using budget-friendly prototyping techniques.

“There’s No Business Like Show Business”: Analyzing Accessibility & Artistic Quality on Broadway

Martin Perez

COM & CFA, Public Relations & Theatre Arts

Advised by Dr. Kristin Leahey, Assistant Professor of Dramatic Literature & Dramaturgy, CFA

Many in the Broadway community have grown weary of the changing nature of theatre, particularly noting a sense of growing commercialism in recent years. Theatre fans point out a large over-reliance on adapting musicals from other previously-acclaimed sources of media, including films, books, albums, etc. This tactic is one of many used to appeal to a larger and more general audience of consumers. However, with these changes also come concerns about the desires of Broadway producers and theatremakers. Many see this lack of originality as a result of producers pandering for profits and prioritizing money over authentic or “hard-hitting” work.

My Keystone project is an interdisciplinary combination of my professional and personal interests in theatre and public relations. Through my research, I aim to analyze the ways in which Broadway has changed to reach its current state, specifically focusing on a timeframe from the 1970s to present day, and investigate how promotional strategies have shifted in order to appeal to changing audiences over time. Using both a theatre history lens and a communications approach, my project examines the development of Broadway from the beginnings of the “concept musical” around the 1970s moving towards the present, considering how trends in historical musical development have influenced contemporary Broadway musical development. Through primary and secondary sources, supplemented by interviews conducted with industry leaders, my project explores how Broadway promotional tactics have changed over the past few decades and considers why these shifts occurred. This study will be useful in finding ways to create work which is both accessible to a greater audience while still maintaining a sense of artistic integrity which promotes meaningful and authentic work over profits.

Leveraging Paired Motion Capture Data to Predict Human Movement

Stanley To

CAS, Computer Science

Advised by Dr. Emily Whiting, Associate Professor of Computer Science, CAS

Motion capture allows us to record our movement, and it has vast applications in films, video games, and biokinetics, which is the study of human movement. For my Keystone project, I teamed up with the BU Shape Lab to investigate the role that motion capture can play in generating realistic 3D character animation, with possible extensions to biokinetics research.

In collaboration with the Movement & Applied Imaging Lab at the Sargent College of Health, we recorded movement for seven participants using force plates, cameras, and reflective markers on the body. Using these tools, we obtained paired ground reaction force data — the force exerted by the ground onto the body, — as well as motion capture data — the position of the markers on the body, — for a set of exercises and poses. Our objective was to train a machine learning model that could predict the ground reaction force for any motion capture data.

This project was very much an exploration of the modern tools and techniques that are used to work with motion capture data. Programming tasks included labeling markers and automating a pipeline for converting motion capture data into a workable form for skeletal animation. The project culminated in training a model with exported motion capture and contact force data then running experiments to generate simulations of realistic human motion.

The outcomes of the project include gaining an understanding of how motion capture is used to animate characters today. We also provide a public data set of paired motion capture data for researchers to utilize, one that leverages data recorded from force plates, which differentiates our data set from previous ones. Ideally, this research study will be beneficial to the animation and biokinetics industry by providing insight for generating more realistic motion for humans.

Per Oculi Antiquitatum: Reframing Modern Politics Through Ancient Art

Carter Fahey

CAS, Classical Civilizations

Advised by Dr. Stephanie Nelson, Professor of Classical Studies, CAS

When discussing ancient history, we often take on the role of an “unbiased observer.” This allows us to set aside our modern preconceptions and approach ancient political issues with a fresh perspective; if we can implement this same mindset when examining modern politics, we can minimize hostility and foster effective problem-solving. In order to cultivate this mindset, I created 6 artistic pieces based on ancient artwork, allowing viewers to engage with contemporary political events as unbiased observers. I engaged with a number of mediums, including woodworking, fresco, sculpture, and composition in both Attic Greek and Latin. Each piece renders a contemporary political issue—such as climate change, modern warfare, or police brutality—into an ancient style. They are accompanied by museum descriptions and translations explaining each work, allowing viewers to further immerse themselves in the perspective of an unbiased observer. When viewed as a collection, this project offers a new perspective on modern politics, inspiring new dialogue about political tensions and paving the way for more productive conversations regardless of political beliefs. These pieces also provide a basis for my future work, which will further explore political themes through the lens of antiquity in both artistic and academic contexts.

In the Belly of the Whale: Applications of Critical Race Theory and Decolonization Theory to Moby-Dick Performances

Anna Rafferty

CAS, English & American Studies

Advised by Dr. Mary Battenfeld, Clinical Professor of American Studies, CAS

The “great American novel” has taken on new meaning in the public consciousness. Recently, countless artists have endeavored to reimagine Herman Melville’s 1851 classic using varying mediums and achieving varying degrees of success; as this trend has settled into our creative culture, theaters across the United States have even begun to reinterpret this novel by placing it in uniquely twenty-first century contexts. Two of these productions in particular, one staged in 2001 by the Perseverance Theater and the other by the American Repertory Theater in 2019, illustrate and exemplify the true malleability of Melville’s initial political commentary. While he did explore American democracy at length, which critics of the early twentieth century focused on, he also aimed to provide a critique of the country’s fraught history with race – and this latter aspect was almost entirely ignored until the Civil Rights movement of the 1960s. Once scholars began to investigate this issue, they realized just how heavily the famous narrative relies on issues of race and Indigeneity. By applying Decolonization Theory and Critical Race Theory to analyses of these contemporary productions, this project reveals just how important race is within the ongoing investigation of Moby-Dick’s racial legacy and thus broadens the conversation surrounding this work far beyond its original limited scope. Both the shortcomings and strengths of these performances illuminate the need for such conversations to continue, urging audiences to reflect upon how their own experiences with theater have either succeeded or failed in attempting to address issues of race. And, ultimately, highlighting these performances using such critical lenses shows how they have become emblematic of racial representations in contemporary American theater.



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Finally, we would like to thank the presenters and all those who attended to support them. Best of luck with all your future endeavors.

The Kilachand Honors College Class of 2023





***"It is not in the stars to hold our
destiny but in ourselves."***

-William Shakespeare



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