Dear friends,

It is my pleasure to introduce and congratulate this year’s impressive group of University Honors Program (UHP) students who have completed their signature capstone theses and independent projects. The work represented here reflects the culmination of hard work and creative and critical thought that highlights their undergraduate education. Our students have contributed to the research enterprise and creative spark of this great public research University. I still have a copy of my undergraduate honors thesis, and I remain very proud of that work to this day. Thus, a capstone is a collective point pride for family and friends and an individual accomplishment that UHP students can draw upon as they transition to professional and graduate schools or embark on their new careers.

It is notable to see the breadth of work represented here, from how psychedelic drugs might be harnessed to treat certain mental illnesses to how the nation’s founders and the tenets of the Constitution were influenced by Roman political thought to advances in health care education at student run clinics to …well, virtually all disciplines at the institution are well represented in this collection. It is a distinctive feature of a UC Davis honors education that students from such a wide range of majors, and from a very diverse set of personal backgrounds and lived experiences, are part of this close community of scholars, and this is beautifully represented in these pages. As you peruse the abstracts, you will notice several projects that were completed on subjects outside the student’s primary major, or that intentionally blended multiple disciplines. This too is encouraged by our program, and it is the students who fully embrace the ability to communicate and work effectively across disciplines and understand multiple perspectives who will be our best problem solvers and difference makers.

In closing, I want to recognize the faculty mentors who lent their valuable time and expertise to help guide (and often times fund) this work. I know that our students are grateful for that critical, multiyear mentorship. I also wish to recognize the hard work of our UHP staff, serving as advisors, confidantes, and at times cheerleaders as the students complete this last significant piece of their UHP journey. The Undergraduate Research Center staff are our valued partners in helping students connect with faculty mentors and showcase their work at the Undergraduate Research, Scholarship and Creative Activities conference each Spring. Likewise, our Engineering majors benefit from the support of their College as they present their capstone work at the Senior Design Project Showcase. Lastly, this booklet was produced with the design expertise of our UE communications team, working closely with the UHP staff to assemble this nice recognition of our students’ research, scholarship and creative work.

It is truly a privilege to serve as Director of the University Honors Program and to support the exceptional achievements of our students through their capstone experiences, across the many disciplines represented in the program. Our students have discovered and created great things already, and will continue to contribute to society as researchers, thought leaders and engaged citizens, and as our newest alumni of UHP and UC Davis.

Sincerely,

J. David Furlow
Director, University Honors Program
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Emotion Regulation for Individuals with Fragile X Syndrome

Emotion regulation (ER) is the combination of physiological, behavioral, and emotional states that provide the tools needed to adapt through everyday situations. Studies often measure ER using rating scales completed by a caregiver, potentially resulting in biased representations of ER. This study aims to examine the construct validity of an observational measure of ER outlined in the Classroom Measure of Active Engagement (CMAE). Participants included 28 males with Fragile X Syndrome between the ages of 15-22 who were recruited for a longitudinal study at the UC Davis MIND Institute. As part of the larger study, video observations of the Autism Diagnostic Observation Schedule (ADOS) were collected, and parents completed a battery of questionnaires to measure anxiety and behavior. Three trained raters coded ER using the ADOS observations; interrater agreement was high (88.87%). Findings indicated significant, positive correlations between emotion dysregulation and salivary alpha-amylase (sAA) readings ($r = 0.622; p \&lt; 0.01$), suggesting an association between ER and psychosocial stress expressed by the sAA recordings. The associations between ER with anxiety and behavior were not significant. These findings offer preliminary support for the validation of the ER construct outlined on the CMAE, and substantiate the role of physiological arousal in ER.

Thermoregulation of Aedes aegypti mosquitoes

Temperature plays an important role in mosquito physiology; like many insects, mosquitoes are ectotherms and must behaviorally thermoregulate to avoid temperature extremes and remain at physiologically suitable temperatures. Behavioral thermoregulation also plays an important role in mosquito-borne virus transmission dynamics by altering the extrinsic incubation period, the time from ingestion of the virus to transmission. However, few studies have been conducted on mosquito behavioral thermoregulation outside of host-seeking behavior. This study will be one of the first to elucidate temperature preferences of the mosquito Aedes aegypti during the critical period from blood feeding through the extrinsic incubation period. We will use a thermal gradient bar with an enclosed Plexiglas arena in a temperature and humidity controlled chamber, providing the mosquitoes the option to land on a metal surface ranging from 18°C to 37°C. Mosquitoes will be placed in the arena and pictures are taken remotely at regular intervals. We will analyze these pictures to quantify the changes in resting behavior as the blood meals are digested. The results we find will help us better understand Aedes aegypti viral transmission and population dynamics. complex mammalian breeding systems.

Evaluating the Impact of Agricultural Waste Products on Enteric Methane Production in vitro

Ruminant livestock production is a major contributor to anthropogenic greenhouse gas emissions, particularly in the form of enteric methane (CH4) production. Enteric CH4 is the result of microbial fermentation of feed within the foregut of ruminant animals. One promising strategy to reduce enteric CH4 without compromising animal productivity is the dietary addition of plant material with anti-methanogenic properties. In recent years some agricultural byproducts, such as grape and pomegranate pomace, have shown CH4 mitigation potential. In addition to reducing overall CH4 emissions, rerouting agricultural waste from the landfill into animal production systems would reduce both total feed costs for livestock producers and the environmental footprint of food production.

Thermal gradient bar with an enclosed Plexiglas arena in a temperature and humidity controlled chamber, providing the mosquitoes the option to land on a metal surface ranging from 18°C to 37°C. Mosquitoes will be placed in the arena and pictures are taken remotely at regular intervals. We will analyze these pictures to quantify the changes in resting behavior as the blood meals are digested. The results we find will help us better understand Aedes aegypti viral transmission and population dynamics. complex mammalian breeding systems.
Humans are innately drawn to the flavors and aromas in meat. We crave it, the thought of it makes our mouths water. But what is the “it” factor in meat that makes it so irresistible, and why do humans continue to choose meat from animals over the plant-based alternatives available on the market today? Flavor is incredibly complex and is linked with many different compounds and their interactions with one another. This paper researches the volatile compounds and flavor molecules, as well as their precursors, that make meat desirable. The source of the fat, whether from an animal or a plant, makes a difference in the flavor compounds produced during the cooking process. This paper looks at plant-sourced fats that may produce similar compounds when cooked to the ones found in meat. The Maillard reactions that cause browning in meats are greatly impacted by the amino acid content. Exploring the amino acid contents of plant-based foods that have meat-like umami flavor, such as mushrooms, nutritional yeast, and soy in comparison with those of meat products, could lead to the discovery of what makes meat delicious.

California is facing a housing crisis. One group that has been highly affected has been the workforce of moderate-income citizens who often have to contribute over 30% of their income towards housing expenses. To answer the question of how best affordable ownership housing programs can serve this group, I analyzed four different models of affordable housing compared to market rate ownership and rental models in the City of Davis. This included Dos Pinos (limited equity housing cooperative), Aggie Village (limited appreciation land trust mode), Southfield Park (limited appreciation condo), and the City of Davis Affordable Ownership Housing Program (limited appreciation single family homes). I compared the level of affordability for each model from the year the model was first implemented in Davis, to their status in 2019. I found that while each model of affordable housing was less expensive than the comparable market rate option, certain models were more effective at producing affordable prices as well as increasing affordability over time. These differences should be recognized, and the most effective models should be implemented in future plans for creating affordable workforce housing.

Recognizing signs of pain or discomfort in donkeys can be difficult due to both their natural instinct to mask signs of weakness as well as their "stoic" demeanors. Even when their pain is identified, donkeys are not always cooperative when it comes to accepting treatment. They are known to hide medication in their mouths and their thicker cutaneous colli muscle makes intravenous drug administration especially difficult. One common analgesic, Flunixin Meglumine (Banamine), is available in an injectable, oral, and more recently, a transdermal form. Proven effective in cattle, this new cutaneous mode has the potential to be a safer and more manageable alternative to administering flunixin. The specific aim of this study is to compare the pharmacodynamics and pharmacology of three routes of flunixin in donkeys (e.g. oral, injectable, dermal). Six donkeys will be used in a three way crossover design in which blood samples will be taken over a 96-hour timeframe for determination of drug and eicosanoid concentrations. The results from pharmacokinetic analysis will be evaluated using appropriate statistical methods. This study could be the first step towards proving that the dermal version of Flunixin Meglumine can conveniently and effectively improve the overall wellbeing of donkeys.
Inhibition of Glycolysis to Promote Tendon Formation

Proper tendon healing can be the difference between an active horse and a debilitated horse. Advancements in repair strategies are required to improve tendon healing in injured horses. Recently, 2-deoxy-d-glucose was determined to be a potent stimulant for the tenogenesis of human stem cells in culture. In this study, we are examining the effect of 2-deoxy-d-glucose on tenogenic properties of stem/progenitor cells derived from the tendon proper and peritenon of the equine super digital flexor tendon. We hypothesize that 2-deoxy-d-glucose will lead to an inhibition of glycolysis which will bolster tendon formation in the progenitor cells. In order to test this, we have provided cells with 0, 10, 100, and 1000 µM of 2-deoxy-d-glucose over a 48-hour period in monolayer culture. We are using real-time quantitative polymerase chain reaction to assay gene expression in response to the glycolysis inhibitor. Concentrations of the glycolysis inhibitor that optimally promote tenogenesis will be further investigated in a three-dimensional tendon construct model before consideration of its application as an equine tendon repair therapeutic.

Behavioral plasticity in personality and dominance in relation to stress response in female Wood Ducks (Aix sponsa)

Animals display personalities through consistent individual variation in behavior in response to their environment. The complex behaviors and social interactions of birds provide an excellent opportunity to relate avian personality to ecology and evolution. Behavioral traits—such as boldness, exploration, and aggressiveness—and plasticity of these traits can greatly impact physiological trade-offs and population dynamics. The Wood Duck (Aix sponsa) is a model species for female sociality and behavioral studies as females are philopatric, exhibit conspecific brood parasitism, and are cavity-nesting—allowing for ample opportunity for female-female interactions. While personality has been explored in many facets, its role in understanding individual stress response has received less attention, even more so in relation to female social hierarchies. This study aims to a) determine long-term plasticity of personality through behavioral assessments and b) contribute to a project relating personality to stress physiology. Behavioral plasticity will be assessed longitudinally by performing standardized behavioral assays of In-Hand Docility Tests (IHDT) and Open Field Tests (OFT) and dominance ranks will be evaluated using food access experiments. These data will then be compared to data from the same birds collected during previous (younger) life stages.

Post Covid19 Air New Zealand Marketing Plan

Covid19 has served as a strategic inflection point to change the landscape of the airline industry and who the dominant players are. Air New Zealand is a premium airline with an opportunity to become passengers first choice when flying. The change in economy, consumer behavior, airline operations and market share pre and post covid have been analyzed to determine how Air New Zealand can uniquely position themselves as a premium airline that will sustain a competitive advantage over other airlines. I have researched the ‘secret sauce’ for what makes premium airlines successful today, and what differentiation possibilities covid19 has given us that Air New Zealand can leverage moving forward. We now exist in a state of post pandemic opportunity – a position that is exciting and uncertain. There is hesitation to travel yet eagerness, and the implications of my marketing plan will reflect the change in airline operations, market share and traveller priorities post covid19, through leveraging the benchmark of responsibility and leadership in New Zealand and the excitement of travel.

Comparing COVID-19 Testing Factors and Data Across University Campuses in the United States

Once it became apparent that COVID-19 was sticking around and continuing to spread, universities were forced to consider how to move forward while keeping campuses safe. Although most universities transitioned to online classes, a portion of students, faculty, and staff were still on campus for numerous reasons. Social distancing, wearing masks, and handwashing were the obvious tactics for reducing transmission, but they were not enough to prevent outbreaks especially when asymptomatic carriers were involved. Many universities developed COVID-19 surveillance testing programs to proactively halt outbreaks and effectively monitor campus health. University surveillance testing programs encourage individuals without symptoms to get tested, minimizing spread through asymptomatic carriers. Additionally, the results of these testing programs and other relevant campus data have been made available to the public through online COVID-19 dashboards. This study aims to collect and compare COVID-19 surveillance testing program designs and testing data across 25 university campuses in the United States. Comparisons from this study will allow us to recognize the diversity among university testing programs and identify trends between contextual testing factors and COVID-19 campus dashboard data. Testing factors include test type, test method, testing accessibility, university testing requirements, testing incentives, and communication of test results. Dashboard data includes, but is not limited to, weekly testing positivity rates and number of tests performed per week.
COVID-19 and the Wine Industry: How the Pandemic Changed the Daily Lives of Industry Workers and Influenced Wine Sales

The international wine industry has been greatly altered since COVID-19 was declared a pandemic in March of 2020. Since the pandemic began, the wine industry has faced significant challenges. These challenges include the following: changes in wine sales (in terms of earnings, sales methods, and products sold), disruptions to the daily routines of wine industry workers, and adjustments in companies' marketing strategies. The industry has had to accommodate the changes caused as a result of the pandemic while remaining relevant to consumers; however, while sales and employment figures have provided quantitative data, there has yet to be any qualitative data that demonstrates the effects of the pandemic on this industry. In this whitepaper directed to the wine industry, I present the stories behind all of these changes, illuminating exactly how COVID-19 has impacted the wine industry and how these adjustments are projected to influence the industry in the long term.

Anna Maddison
Major: Environmental Toxicology
Mentor: Dr. Michele La Merrill
Research Type: Honors Thesis in Major
Investigation Of Substrate Processing In the Liver To Help Explain The Association Between Fatty Liver And Pesticide Exposure

Nonalcoholic fatty liver disease (NAFLD) affects a quarter of the world population and is associated with heart dysfunction, hepatic insulin resistance and increased occurrence of hepatocellular carcinoma. Insulin resistance is especially prevalent in South Asians, but findings suggest this is not attributable to genetics or diet alone. Rather, increased incidence of type 2 diabetes in South Asians is associated with higher levels DDT exposure. A possible mechanism for this finding is insulin resistance due to increased hepatic lipids, which is supported by animal studies showing DDT causes increased hepatic cholesterol, lipids, and lipogenic enzymes [MALM]. In this study, we aim to investigate the relationship between DDT and NAFLD by investigating gene expression patterns in the livers of perinatally exposed female mice which could indicate altered hepatic lipid metabolism. We expect changes in RNA consistent with NAFLD, specifically, upregulated expression of Lpl, Glut2, Cyp7a1, ChREBP, ACC1, and Srebf1 and downregulated expression of PPARα and CPT1α. By understanding the mechanism of the underlying relationship between DDT and excess hepatic fat we can make better decisions regarding future pesticide use and treatment of NAFLD.

Mengmeng Luo
Major: Sustainable Agriculture and Food Systems
Minor: Sustainability in the Built Environment and Studio Art
Mentor: Dr. Kate Scow
Research Type: UHP Thesis
Impacts of Long-term Dairy Manure Amendments on Soil Carbon and Microbial Community Dynamics

The application of animal manure as a soil amendment has the potential to build up soil organic carbon (C), forms good soil structures to support plant growth, and provides slow-release nutrients for crops and energy/C sources for soil microbial communities. In a field study of a corn-wheat forage rotation over five growing seasons, we compared three manure treatments with same total nitrogen (N) input: 1) 100% mineral fertilizer, 2) 50% mineral fertilizer, and 50% dairy manure, and 3) 100% dairy manure. One-meter soil cores were collected at the end of the field trial. Soil physicochemical properties, soil water-stable aggregates, microbial-available C, C distribution in soil structure, and microbial community composition were contrasted at different soil depths (0-15, 15-30, 30-60, and 60-100 cm). Our results indicated that both levels of manure amendments significantly increased total and reactive soil C storage in topsoil while not deeper layers. Manure amendments boosted soil microbial biomass in all layers, and its impact diminished as soil depth increases. High-level manure amendment resulted in a significant amount of manure-C in water-stable aggregates. The findings of this study would be helpful to inspire the development of sustainable agricultural practices that support crop productivity, soil health, and ecological resilience.

Angelica Martinez
Major: Animal Science
Mentor: Dr. Kristina Horback
Research Type: UHP Thesis
The Effect of Rearing Environment Complexity and Depth on Laying Hen Jumping Behavior Over Time

Recent legislation in California requires cage-free housing for egg-laying hens and it does not specify what the rearing environment should include, which has important implications for animal welfare. Rearing environment complexity, through perches and varying tiered structures, has the potential to affect future spatial and physical ability. Similarly, depth, or vertical distance from the ground, could affect jumping behavior in laying hens. Therefore, this study will measure the effects of rearing environment complexity and depth on laying hen jumping ability over time. The study design involved three different rearing environments: floor reared, single-tier, and multi-tier. Laying hens were assessed using a modified visual cliff, an added perch and platform, with three depths (15, 30, 90 cm) being tested at three ages (8, 16, and 30 weeks). A random sample of 270 trials where hens crossed the visual cliff were selected for behavior coding using Observer software. The following behaviors were recorded to measure jumping ability: latency to achieve balance, wing flaps, foot adjustments, and tail position. I hypothesize that laying hens will have better jumping ability with shallower cliff depth and when reared in more complex environments.
Zoe Mitchell
Major: Food Science
Mentor: Dr. Maria Marco
Research Type: UHP Thesis

Chemical and microbial characteristics of olive fermentations performed at home

Little is known about the chemical properties and microbial contents of food fermentations performed at home. For this study, we investigated the home fermentation process for Sicilian-style olives. In total, nine 1-gallon fermentations were initiated by six participants using the same recipe and source of Sevillano olives, water, salt, and white distilled vinegar. Three of the participants prepared replicate fermentations. The olives and brine were initially sampled every day for the first week and then biweekly for the remaining four months. At the time of submission, the pH was 2.6 ± 0.1 and salinity was 62.8 ± 7.0 ppm. The pH increased and salinity decreased over time such that the brine was replaced after 9 weeks to maintain food safety. Replicate buckets showed similar, but not identical trends. During brine change, two replicate buckets had a pH difference of 0.2 and salinity difference of 5 ppm. Visual analysis of brine surfaces also indicated highly variable development of yeast pellicles between all nine buckets. The findings from this study showed the variability of home fermentations, even when performed using the same initial ingredients and conducted in parallel by the same individual.

Rebecca Moore
Major: Animal Science
Minor: Social and Ethnic Relations
Mentor: Dr. Maja Makagon
Research Type: UHP Thesis

Hens in Backpacks: Does the Weight of the Sensor Impact Their Behavior?

An increasing number of researchers rely on animal mounted sensors for automated data collection, but do these sensors change the animal’s behavior thus influencing the data? Using the laying hen as a model, we sought to determine whether the weight of the sensors (ranging from 3.3% to 7.2% of their bodyweight) impacts their movement within a multitiered aviary structure. We hypothesized that hens with heavier sensors would have more difficulty transitioning between vertical tiers but would habituate to sensor weight over time. Hens (n=59) were housed across six pens. Of these, 50 were individual marked and assigned to one of five treatment groups (four sensor weights and a control). The hens were observed 1 and 12 days after receiving sensors for 3 hours/day. We recorded the number and success of transitions between vertical tiers for each hen. Preliminary results (based on data from two pens) suggest that the presence of a backpack weight impacted the number of transitions attempted, regardless of sensor weight category. The success of transitions was only affected on the first day of observation, indicating the hens habituated to the presence of the sensor.

Landin Noland
Major: Ecological Management & Restoration
Mentor: Dr. Valerie Evner
Research Type: UHP Thesis

Resilience of Chaparral Systems: Effects of a Short Fire Return Interval on Chaparral Regeneration in the Pepperwood Preserve

California’s chaparral has evolved with fire, yet little is known about how increased fire frequency will change post-fire recovery, and thus the persistence of this ecosystem under a changing fire regime. Chaparral species have two major mechanisms of post-fire regeneration, germination from surviving seedbank or sprouting from surviving root systems. Significant concern exists that short fire return intervals can compromise both mechanisms, killing emerging seedlings before they mature. This could lead to conversion of chaparral to grassland. I will assess the impact of frequent burns on chaparral recovery at Pepperwood preserve, which nearly completely burned in the 2017 Tubbs fire and a portion of which re-burned in the 2019 Kincade fire. I will monitor chaparral areas burned once versus twice and compare: (1) regeneration of shrub seedlings derived from resprouting versus germination, (2) grass cover and biomass, and its fuel potential to carry a future fire; and (3) the prevalence of ephemeral fire-following species. These results will fill knowledge gaps in chaparral ecosystem function which will be critical for predicting its persistence under a changing climate and provide insight to land stewards seeking to maintain diverse ecosystem services, utilize cultural or prescribed burning, mitigate wildfire damage, or amplify post-fire recovery.

Megan Phelps
Major: Environmental Science & Management
Mentor: Dr. Gwen Arnold
Research Type: Honors Thesis in Major

One Climate Crisis, Many Climate Solutions: Differences between Prognostic Frames Employed by Climate Organizations in San Diego

Climate activism and advocacy has escalated in recent years, with figures like Greta Thunberg at the forefront of what people might think of as a single, unified global climate movement. However, this movement is far from homogenous. Though climate organizations are motivated by the same broad topic of climate change, how do their narratives surrounding (i.e., framing of) climate solutions differ? How does framing correlate with socio-demographic and political affiliation of members within climate organizations? This article attempts to answer these questions, using three San Diego climate organizations as case studies. The study employs surveys to determine socio-demographic and political characteristics. It uses interviews; online content, including websites, mailings, press releases, and social media; and observations from meetings to analyze key themes in each organization’s climate solution framing. Results will illustrate whether organizations fill different “niches” by using distinct frames to appeal to different participants. Findings will also point to possibilities for coalition building within the climate movement as a whole: by acknowledging divergence in the way social movement organizations define climate change, these groups can unify around shared goals to demand the rapid, far-reaching change required to address the global climate threat and preserve the livability of the planet.
Humans have increasingly disturbed natural habitats through urbanization, which has resulted in the loss of wildlife biodiversity. Some primate species have been able to adapt to human disturbance in urban areas, while other species only occur in non-urban areas. Primate species that are able to adapt to urban areas may be predisposed to this ability due to the behavioral traits that are expressed in their natural environment. The objective of this study is to identify the factors that allow some primate species to live in urban areas. We collected data from 3000 primary literature articles which were compiled in the Primate Social Behavior and Conservation database from the Caillaud lab. We collected data for 68 urban-adapting primate species and 192 non-urban primate species. We analyzed our data using phylogenetically controlled generalized least squares regression in R. We compared the average percent time feeding and foraging and the variability in percent time engaging in social behavior between urban-adapting and non-urban species. Preliminary analyses suggest that urban-adapting species in their natural environments tend to spend a higher percentage of their activity budget feeding and foraging and have a more variable engagement in social behavior compared to non-urban species. Therefore, primate species that show these behavioral traits in their natural habitats are more likely to be able to adapt to urban areas. These results should be taken into consideration during conservation efforts to prevent the artificial selection for urban-adapting species and the eradication of non-urban species.

**Behavioral Differences Between Urban-Adapting and Non-Urban Primate Species**
**Quentin Thouvenot**

Major: Animal Science  
Mentor: Dr. Kristina Horback  
Research Type: UHP Thesis  

**Aggressive and Exploratory Behaviors in Growing Gilts during Farrowing and Nursery Phases**

It is known that aggressive behaviors among growing piglets can lead to injuries among these animals, leading to significant financial ramifications for producers within the US pig industry. Video and audio recordings of a single litter housed at the UC Davis Swine Teaching and Research Facility (n = 5 gilts, and n=4 boars) were analyzed for the prevalence of aggressive and exploratory behaviors occurring within farrowing and nursery pens. The goal of this study was to determine if aggressive/exploratory behaviors performed by the gilts while in farrowing pens would continue to occur at a similar prevalence when these gilts were moved to nursery pens with their litter. Gilts were focused on specifically because they had been numbered individually for a previous study and were thus easier to identify. Behaviors recorded included: headbutting, biting, shoving/pushing, chasing, levering (aggressive), and sniffing (exploratory). Both prevalence and duration of the behaviors were recorded (162 mins in farrowing pen, 378 mins in nursery pen). Teat ranks during observations in farrowing pens were also recorded. Upon examination of recorded data, it was found that gilts 4 and 5 displayed the most aggressive and exploratory behaviors in both farrowing and nursery pens, while gilt 1 displayed little to none of these behaviors, and was often the recipient of fights that occurred. Teat rank interestingly mirrored this trend of dominance for gilts 4, 5, and 1, with gilts 4 and 5 occupying a more favorable teat position (nearest to the sow's head for better milk quality), and gilt 1 occupying the least favorable teat position (bottom last teat pair). This study offers further insight into the aggressive/dominance dynamics within an isolated, growing litter of piglets, and may be used to better understand and explain aggressive behaviors within growing piglets and how these in turn affect financial dynamics within the US pig industry.

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**Rasika Venkatesh**

Major: Biotechnology  
Mentor: Dr. Luis Carvajal-Camona  
Research Type: Honors Thesis in Major  

**Admixture Analysis of Hispanic Populations in TCGA Database for Gastric Cancer Mutations**

Gastric cancer (GC) is the third cause of cancer-related deaths worldwide and limited research has been done regarding its etiology and genetics in non-European populations. Understanding the genetic etiology of GC is important in alleviating health disparities among minority populations, particularly in Hispanic patients who are twice as likely to die from GC. Towards this end, this study aims to identify novel germline variants associated with GC and determine the prominence of certain mutations in various populations through global and local genetic ancestral analyses. Utilizing local ancestry analysis in examining the genetics of complex traits has the potential to increase our ability to detect genetic associations in understudied admixed genetic ancestral populations. We will use admixture analysis, which looks at regions or variants and ancestry within the GC patient population against a reference control population of individuals with non-gastrointestinal cancers, to identify novel variants associated with GC in EUR, AFR, and AMR genetic ancestral groups. This analysis will provide etiological information that furthers our understanding of GC in Hispanic populations, which may aid in the identification of individuals at high risk for GC and the development of additional treatments.

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**Jennifer Leonita Wijaya**

Major: Food Science  
Mentor: Dr. Juliana De Moura Bell  
Research Type: UHP Thesis  

**Effects of Extraction Parameters on Extractability and Functional Properties of Lentil Proteins**

The need for alternative protein sources, especially plant proteins, has increased in popularity in the food industry in recent years due to its high nutritional value and its role in supporting sustainability. Legumes, particularly lentils, are widely known as prominent sources of proteins. Lentil proteins are a source of essential amino acids and possess a wide range of functional properties that open up their potential use in several food product applications. Various extraction conditions have been used to extract lentil proteins. However, the effects of key extraction parameters on the extractability and structural modifications of lentil proteins, the latter having a key impact on the technological and functional properties of the extracted protein, remain unclear. This review highlights the effects of different extraction methods on the extractability of lentil proteins and focuses on how the extraction parameters could as well affect the functional and the biological properties of lentil proteins.
Maize is a vital crop for both income and food security in Sub-Saharan African countries, such as Mozambique and Tanzania. Drought tolerant (DT) maize varieties have been developed and proclaimed to be an important technology that will offer protection for small farmers. On-Farm trials by The International Maize and Wheat Improvement Center have shown a 10% yield advantage for DT maize varieties over comparison maize varieties, with that advantage growing to 12% under drought conditions. However, it is still unknown whether a yield advantage can be found when using DT maize exists for small farmers in practice, and under what types of weather conditions that advantage exists. I analyze data from small farmers in Mozambique and Tanzania to determine whether a yield advantage can be found when treatment groups in these countries are offered DT maize. Using both a difference-in-difference and ANCOVA regression technique, I estimate the impacts of DT maize on yields in different combinations of weather conditions concerning mid-season and early-season drought. I find under both difference-in-difference and ANCOVA regression techniques, there is a substantial yield advantage for treatment groups offered DT maize over control groups during mid-season drought; however, when preceded by an early-season drought, the yield advantage of DT maize under mid-season drought is heavily offset.

Fens are perennially wet, groundwater-dominated ecosystems that provide refugia for native species during the summer dry season in California. This study focused on the impacts of manmade drainage ditches on soil structure and wetland-dependent vegetation in alpine fens. Surveys were conducted in fall of 2020 in the Childs Meadow complex, which is an ongoing meadow restoration site in the Lassen National Forest in California. Sample plots were located above (upslope) and below drainage ditches in two fen locations within the complex. Soil cores were collected in each plot and analyzed for mineral and organic content, texture, color, and depth to groundwater. Percent cover of representative wetland-dependent species, such as Sphagnum spp. moss, was estimated in each 40 by 40 cm plot. Above-ditch plots had considerably wetter soils with higher organic matter content, as well as greater percent cover of Sphagnum moss. In both fen locations, areas below the ditches had reduced organic soil components, increased grass cover, and greater depth to groundwater. This study provides a baseline of soil and vegetation conditions in two impacted fens in Childs Meadow. Continued annual monitoring of the study plots will provide valuable data on the impacts of restoration actions planned for 2022.

The Type VI Secretion System (T6SS) is an important structure that mediates interbacterial competition in gram-negative bacteria. The molecular syringe-like apparatus uses a contracting mechanism that allows the bacteria to shoot toxic proteins called effectors across its cellular envelope into other bacteria. For each effector, there is a corresponding immunity protein that protects the bacteria from the effector. This allows the bacteria to kill foreign bacteria without hurting themselves. Previous random barcoded transposon site sequencing (RB-TnSeq) data showed that immunity genes were vital for the growth of plant pathogenic Ralstonia in planta. We explored the function of effectors without their respective immunity proteins in E. coli using pBAD18 plasmids with an arabinose inducer. We saw a reduction in E. coli colonies when the effector gene was expressed. This is consistent with previous research showing the toxic effect of effectors when immunity proteins are not present. A greater understanding of the T6SS will allow researchers to manipulate it for in planta use.
During brain development, thyroid hormone (TH) plays a vital role in regulating gene transcription via its two forms, T4 and T3, guiding processes that shape the brain for optimal function throughout the lifetime. Past research in rodent models sought to identify the TH signaling pathway components and regulated genes in the developing brain, but many of the specifics, particularly direct transcriptional targets of T3, remain unknown. The aim of this study was to use transcriptomic data from T3-treated Xenopus laevis tadpole brains to characterize the gene expression profile in this amphibian model of TH action, in comparison to other vertebrates. As hypothesized, we found that many known regulators of TH, such as thyroid hormone receptors α and β, deiodinases 2 and 3, retinoid x receptors α, β, and γ, scc16a2, ncoa1, ncor1, and ncor2, were present in the Xenopus brain transcriptome. Additionally, we identified a handful of genes previously recognized as direct targets of TH in mammalian systems, most notably klf9. These results provide further evidence that TH signaling in the brain is conserved across species, and suggest the presence of a core group of genes that are consistently targeted by T3 amidst its otherwise broad array of transcriptional targets.
after replication stress contributes to maintaining chromosome stability frequency of cells with unresolved UFBs and DNA damage nucleophagy pathway and analyze their response to replication hypothesis the maintenance of chromosome stability Thus (by unreplicated DNA nucleophagy of MN by targeting partially formed nuclei through chromosome nondisjunction and the formation of micronuclei (genome daughter cells receiving identical copies of their parent chromosome). Inhibitor PHA To do this, we will inhibit its activity with a known Cdc7 inhibitor PHA-767491. If Cdc7 activity is necessary for DSB formation, we would expect to see diminished numbers of chromosome-associated foci of RAD51 and RPA, two proteins that bind the ends of DSBs.

Sexual reproduction relies on meiosis, a cell division defined by one round of replication and two rounds of chromosome segregation that produce haploid gametes. In this study, we aim to establish an ex vivo ovary organ culture as an experimental model system to study key meiotic prophase events during oogenesis. To do so, we harvested fetal ovaries at E12.5, a stage when mitotically dividing germ cells will soon enter meiotic prophase I and cultured them for several days. To monitor meiotic progression, we took cultured ovaries and prepared chromosome spreads, then used immunofluorescence to visualize marker proteins associated with different substages of prophase I. After we determine that our ex vivo organ culture is a viable model to study meiosis, we plan to test whether the protein kinase Cdc7 has a conserved role in mammalian meiosis to trigger the initiation of recombination via DNA double-strand break (DSB) formation. To do this, we will inhibit its activity with a known Cdc7 inhibitor PHA-767491. If Cdc7 activity is necessary for DSB formation, we would expect to see diminished numbers of chromosome-associated foci of RAD51 and RPA, two proteins that bind the ends of DSBs.

Cell division is a highly regulated process that results in two daughter cells receiving identical copies of their parent genome. Replication stress that delays genome duplication can slow sister chromatid resolution, giving rise to ultrafine bridges (UFBs) in anaphase. UFBs are linkages that join sister chromatids and prevent segregation, leading to pathological chromosome nondisjunction and the formation of micronuclei (MN). It is proposed that autophagy suppresses this formation of MN by targeting partially formed nuclei through nucleophagy. Our previous studies indicate that this pathway is regulated by the Intra-S-Phase kinase cascade and is triggered by unreplicated DNA. Additionally, we found that the drug hydroxyurea activates replication-stress induced nucleophagy (ReSIN) to ensure the proper resolution of sister chromatids. Thus, we hypothesize that the ReSIN pathway contributes to the maintenance of chromosome stability. To test this hypothesis, we will engineer cells with mutations in their nucleophagy pathway and analyze their response to replication stress through the incidence of Rad52-GFP repair foci. We predict that nucleophagy mutants will lead to an increase in the frequency of cells with unresolved UFBs and DNA damage, as detected by Rad52-GFP, supporting the idea that nucleophagy contributes to maintaining chromosome stability, especially after replication stress.
**Star Ghanaat**  
**Major:** Biological Sciences  
**Mentor:** Dr. Mona Monfared  
**Research Type:** UHP Thesis  

*A Patient-Facing Intervention for Weight-Neutral Care: Diet Culture in the Doctor’s Office*

The purpose of this patient-facing guidebook is to increase patient familiarity with the biological and social frameworks associated with obesity spread awareness about the importance of challenging diet culture, and inform patients of weight-neutral approaches to obesity, especially within the Sacramento area. While current clinical practice centers weight loss in treating obesity, weight-neutral approaches have a smaller body of scholarship. This guidebook will explain how prioritizing biomarkers, mental health, and nutrition can lead to equal or better outcomes for patients with obesity. This guidebook uses scientific review articles and individual studies from the past five years in the United States and in Europe to discuss topics like weight bias, causes and effects of obesity, and effectiveness of weight-neutral compared to weight loss-centered approaches. Additional research needs to be conducted to confirm specific findings, such as self-compassion-based approaches improving nutrition behaviors and body image, and to expand on more biochemical and genetic mechanisms behind obesity. This guidebook should be distributed to mental health clinics, medical centers, and dietitian offices to increase patient awareness about obesity and weight-neutral approaches, and distributing this guidebook to medical centers and nutrition departments within medical schools will also increase provider awareness of weight-neutral approaches to obesity.

**Madeline Handy**  
**Major:** Microbiology  
**Minor:** Political Science  
**Mentor:** Dr. Rachel Vannette  
**Research Type:** Honors Thesis in Major  

*A Comparison Between the Gut Microbiome Composition of the Carpenter Bee Species Xylocopa sonorina and Xylocopa tabaniformis*

The gut microbiota of bees has been shown to play a role in nutrition, immunity, and host fitness, making microbiome studies increasingly significant to our understanding of these important pollinators. Differences in the microbiome composition between social and solitary bees have pointed to social transmission as a key aspect in the maintenance of a functional microbiome. The goal of this study was to explore what roles host species, sociality, and environment play in gut microbiome composition by comparing the microbiomes of two carpenter bee species: Xylocopa sonorina and Xylocopa tabaniformis. Carpenter bees are considered solitary; however, X. sonorina has been seen to exhibit semi-social behavior which provides an opportunity to see how semi-social behavior influences the microbiome. Samples for both species were collected from Davis, CA along with samples of X. sonorina collected in Tempe, Arizona and X. tabaniformis collected at Anza-Borrego Desert State Park in California. Preliminary results for samples from Davis, CA suggest that X. sonorina and X. tabaniformis differ in the bacterial composition in the gut, though both are heavily dominated by the genus Lactobacillus. Further analysis will examine how host species and geographic location interact to form the gut microbiome in these two bees.

**Sabah Khan**  
**Major:** Biological Sciences  
**Minor:** Technology Management  
**Mentor:** Dr. Dave Furlow  
**Research Type:** Honors Thesis in Major  

*One Students Path in Entrepreneurship: BioBandage*

In my UHP Signature Work, I will be walking through my journey with Biodesign leading me to creating a product and taking an entrepreneurship path with a startup company while in undergraduate studies. Through this one student perspective, I discuss my path coming into UC Davis, how I joined the Biodesign Challenge, meeting my team, creating our company, Biobandage, and the many steps we took along the way. During this path, I learned how to take different disciplines, such as science and business, to merge them together into this project. There were challenges and obstacles through this process and many learning opportunities that I hope will be able to help other students who may be considering an entrepreneurship path.

**Bryant Law**  
**Major:** Neurobiology, Physiology & Behavior  
**Mentor:** Dr. Mitchell Singer  
**Research Type:** UHP Thesis  

*Characterization of Defensin Protein Usage by Myxococcales During Development and Hunting*

Myxococcales are unusual amongst prokaryotes for their expression of defensin proteins, which was previously only known to be expressed in Eukaryotes as an antimicrobial. With an incomplete understanding of the role Defensins play in humans, our lab studies the use of defensin in Myxococcales’ development and hunting to extrapolate the usage of the protein for both Myxococcales and humans. Finding characteristic defensin cystine pattern in several Myxococcales, our lab attempted to elicit the function and expression of defensins in M. fulvus B02, M. macrosporus HW-1, and M. xanthus DK1622 based on RNA seq. After filtering data and molecular modeling of hypothetical, putative, uncharacterized, unnamed, defense and defensin characterized proteins from the NCBI non-redundant reference sequence database, we selected four defensin genes. Each gene was examined using knockout mutations via electroporation of the vector plasmid pBJ14 and cloning with E. coli DH5α. We also assessed the usage of defensin as a tool for hunting with P. carotovorum JL1134, P. syringae pathovar allsaliasis, S. marcescens ATCC 39006, S. suberificiis CAI, and X. campestris pathovar vitians BS339.
Tendons and ligaments determine whether a ketogenic diet has a negative impact on ligament structure. A high fat content compared to control glucose significantly decreased ligament mechanics and collagen content compared to control glucose. Free PA for 7 days with refeeding every other day (and subsequently treated with either bovine serum albumin BSA) engineered into ligaments between calcium brushite anchors. Cultured human ACL cells were embedded into a fibrin gel engineered anterior cruciate ligament constructs. We observed that saturated fatty acids significantly decreased collagen content compared to control PA. This study examines the effect of a high fat-low carbohydrate environment on in-vitro engineered anterior cruciate ligament (ACL) constructs. Cultured human ACL cells were embedded into a fibrin gel, engineered into ligaments between calcium brushite anchors, and subsequently treated with either bovine serum albumin (BSA) control, palmitic acid (PA, 16:0), glucose free BSA, and glucose free PA for 7 days with refeeding every other day. Glucose free BSA treatment did not significantly alter the mechanical and material properties but significantly decreased collagen content compared to control. PA either with or without glucose significantly decreased ligament mechanics and collagen content compared to control. These results suggest that a high fat-low carbohydrate environment decreases ligament structure/function. In vivo research is needed to determine whether a ketogenic diet has a negative impact on tendons and ligaments.

Saturated Fatty Acids Decrease Collagen Synthesis and Function of Engineered Human Anterior Cruciate Ligaments

The ketogenic diet is a popular diet trend emphasizing consuming low carbohydrate and high fat foods with many purported benefits: weight loss, reducing cancer risk, and decreasing heart disease, among others. Previously, we have observed that saturated fatty acids significantly decreased ligament mechanics and collagen content in in-vitro human engineered ligament constructs. This study examines the effect of a high fat-low carbohydrate environment on in-vitro engineered anterior cruciate ligament (ACL) constructs. Cultured human ACL cells were embedded into a fibrin gel, engineered into ligaments between calcium brushite anchors, and subsequently treated with either bovine serum albumin (BSA) control, palmitic acid (PA, 16:0), glucose free BSA, and glucose free PA for 7 days with refeeding every other day. Glucose free BSA treatment did not significantly alter the mechanical and material properties but significantly decreased collagen content compared to control. PA either with or without glucose significantly decreased ligament mechanics and collagen content compared to control. These results suggest that a high fat-low carbohydrate environment decreases ligament structure/function. In vivo research is needed to determine whether a ketogenic diet has a negative impact on tendons and ligaments.

Function of Engineered Human Anterior Cruciate Ligaments

In Vitro 3-Dimensional Coculture with Fibroblasts Maintains the Phenotype of Primary Rhesus Macaque Type II Alveolar Epithelial Cells

Type II alveolar epithelial (AT2) cells are specialized cells that make up approximately 5% of the surface area of the alveoli. AT2 cells are responsible for the production of surfactant as well as several antimicrobial agents. They also function as progenitor cells for the repair process after lung injury. Despite their importance to pulmonary biology, AT2 cells remain relatively understudied because they are very difficult to culture in vitro. In a conventional two-dimensional culture system, primary AT2 cells lose their distinctive phenotype within 3-5 days, which makes this system unsuitable for most studies. To solve this problem, we utilize a three-dimensional coculture system employing primary rhesus macaque fibroblasts to maintain the phenotype of primary rhesus macaque AT2 cells. In this system, the primary AT2 cells are grown in a monolayer on top of a Matrigel matrix containing the primary fibroblasts. The contact between the fibroblasts and AT2 cells, in addition to growth factors present in the culture medium, maintains the sftpC phenotype of the AT2 cells for at least 7 days. This model will enable further investigation into the effects of various compounds including wildfire ash and e-cigarette liquids on the health and function of AT2 cells.
The rodenticide tetramethylenedisulfotetramine (TETS) is a convulsant agent that is considered to be a chemical threat agent by the United States Department of Homeland Security due to its high toxicity and ease of synthesis. TETS cause seizures that can rapidly progress to status epilepticus (SE) by blocking the GABAA receptor channel. The GABAA receptor is normally activated by the primary inhibitory neurotransmitter in the brain. There is no established antidote for TETS exposure, and current countermeasures include administration of standard anticonvulsant agents to control seizures and increase survival. However, these treatments do not protect against the long term morbidity associated with TETS poisoning, which includes recurring seizures, cognitive deficits, and affective disorders. To determine and evaluate the appropriate antidote for TETS, a preclinical model that recapitulates the neuropathology reported in humans that survive TETS-induced seizures is needed. Thus, we are characterizing a mouse model of TETS-induced SE using the NIH Swiss mice. In this model, a single administration of TETS induces SE in &gt;50% of exposed mice who exhibit a seizure duration of more than 40 min. The neuropathology associated with TETS-induced SE was characterized by immunohistochemical analyses of astrogliosis and microglia activation in specific brain regions at varying times post-exposure. Our preliminary data indicate that there is increase in astrogliosis and microglia activation in specific brain regions 3 days following TETS exposure. This work is supported by funding from the NIH (CounterACT grant U54NS079202).

Collagen is the most abundant protein in the body and functions to provide the mechanical strength of connective tissues. In muscle, collagen fibrils function both to hold muscle fibers together and transmit force laterally between fibers. With aging, force transmission and muscle mass is reduced; however, how changes to specific collagen isoforms or the matrix orientation contribute to force loss is currently unclear. The purpose of this study is to compare lateral force transmission in young and old people with changes in specific collagen proteins and the orientation of the matrix. To study this comparison, cross-sections of the gastrocnemius muscle were taken to determine specific collagen content, while longitudinal sections were stained with picrosirius red to determine matrix orientation. Fibrillar collagen isotypes I and V tended to increase with age, while circumferential collagen isotype VI decreased with age. Picrosirius red staining showed that the collagen matrix is oriented at a 22.3±3.1% angle to the fibers in young and 30.2±8.7% in old subjects. By establishing the role of specific collagen proteins during aging, we hope to better understand the relationship between the extracellular matrix and force transmission in muscle and how this relationship is modified by age.
The Disproportionate Effects of the COVID-19 Pandemic on the Latinx Community's Physical, Financial, and Mental Health

The factors associated with social cognition in children with ASD

This study examined differences in children and adolescents with autism spectrum disorder without intellectual disability (ASD-WoID) and a typically developing (TD) comparison sample on measures of Theory of Mind (ToM) to test whether diagnostic groups differences could be explained in terms of variance on measures of working memory, inferential thinking, or verbal IQ (VIQ). There were 81 children in the ASD-WoID group and 44 children in the TD group between the ages of 8-15 years. The results show that the ASD-WoID group significantly differed from the TD group on the ToM, inferential thinking, and working memory measures, but there was no interaction of diagnostic group and VIQ group. Working memory and inferential thinking correlated with ToM in the ASD-WoID sample only. ToM performance significantly and independently differentiated many, but not all, ASD-WoID and TD participants above and beyond the effects of working memory and inferential thinking. Neither working memory nor inferential thinking measures impacted ASD-WoID identification, but the former differentiated the diagnostic samples. The findings were consistent with the hypothesis that ToM performance is associated with domain-general cognitive abilities such as working memory and inferential thinking in ASD-WoID. However, the findings also support the idea that ToM deficits in ASD-WoID are not solely explained by impairments in more general cognitive abilities.

Expanding Students Opportunities in Biodesign

Biodesign is a growing, multidisciplinary field that aims to create more sustainable products by exploring biological mechanisms to solve global issues. The aim of this research is to discover optimal ways to get students interested in and involved with biodesign, as well as support their efforts to turn their ideas into careers. This ongoing research will utilize interviews with educators in fields related to biodesign, programs such as the Biodesign Challenge that inspire biodesign innovation, as well as students and entrepreneurs who are currently working on biodesign products. Based on the information gathered from these sources, interactive problem-solving workshops and interview videos illustrating the design process will be created. These resources will help educators determine the best types of programs, such as implementing a biodesign major or minor, or implementing a problem-based approach to biodesign in course activities, would best benefit their students, and inspire them to further develop their ideas.
Chromosomes are complex genetic structures containing identifiable elements such as genes and transposons. During Prophase I of meiosis, homologous chromosomes can exchange segments through the process of recombination. It is not entirely clear how genes and transposons affect recombination. Previous studies in plants and animals have shown that along a chromosome, recombination frequency tends to be positively correlated with genes and negatively correlated with transposons. Chromosomes can differ in number, size, and composition between the genomes of different species. Understanding how the density of genes, transposons, and recombination events vary within chromosomes of different size and organization is important because these properties affect genome maintenance and evolution. Here we show the comparative distributions of genes and transposons within the chromosomes of three plant species: Arabidopsis thaliana, Solanum tuberosum, and Solanum lycopersicum, as well as the distribution of recombination frequency in A. thaliana and S. lycopersicum. We found an inverse relationship between gene and transposon density. Additionally, we found a positive relationship between gene density and recombination frequency in the two species where this was examined. Our results confirm past findings in other species that show a relationship between genes, transposons, and recombination frequency in plant genomes.

Yeasts are unicellular fungi that consume sugar to produce their cellular components. Some yeasts are currently used in livestock feed as a high protein supplement. These yeasts are unable to utilize the sugar galacturonic acid, a monomer of pectin, efficiently. Galacturonic acid is a dominant carbon source in almond hulls, low value by-products produced during almond harvesting. The goal of this research was to identify yeasts that can metabolize a large proportion of almond hull carbon compounds while producing high amino acid concentrations essential for animal feed. By doing so, we will be able to reduce almond industry waste while maximizing sustainable sources of protein for livestock. The Phaff Yeast Culture Collection at UC Davis contains over 1,000 yeast species which allowed for the selection of strains based on promising characteristics such as the potential to accumulate high protein concentrations. They were screened in laboratory media with nutrients found in processed almond hulls, then cultured in real almond hull hydrolysate. Then, we determined the total protein and amino acid composition. We found that two strains were able to successfully consume galacturonic acid in lab media and are continuing to confirm its ability to do so in real almond hull hydrolysate. My part in this study focused on collecting yeast growth data through different methods for the creation of correlation plots used to estimate the mass of yeasts grown on almond hull media rather than lab media.

Although evidence is still minimal, there has been increasing recognition of the role the amygdala plays with autism spectrum disorder (ASD). Our primary goal is to map synaptic density, both excitation and inhibition, of the human and non-human primate amygdala across age. With this new data, we may also determine how the neural trajectory differs in the brains of patients with autism, and how synaptic density may differ in monkeys prenatally exposed to maternal immune activation (MIA model). The subjects will likely begin as non-human primate models, but we are in the midst of finalizing the protocol for collecting human samples. The method of mapping synaptic densities will be done with array tomography (AT), a newly developed microscopy tool that detects antibodies against synaptic molecules. Array tomography outputs 3-dimensional, ultra-high resolution images of resin embedded tissue sections that have been stained with fluorescent antibodies. Our plan to quantify synaptic density in the amygdala begins with manually adjusting the array tomography R-program to fit our synaptic size, tissue type, and machinery. We hope that with AT, mapping the developmental trajectory of the amygdala across age groups will further our understanding of ASD.

Current treatment of cancer relies significantly on the use of targeted therapeutics. There are a multitude of compounds with diverse primary targets developed for a number of different tumor types. Unfortunately, these compounds tend to have off-target effects. Specifically, the effect these compounds may have on gene regulation is still unknown. Understanding the effect of compound exposure on transcriptional regulation in cancer cells would provide insight into which genes and pathways might be directly targeted by each compound. Towards this goal, we analyzed transcriptional responses of three cancer cell lines (A549, K562, MCF7) to a large panel of 188 compounds, exposed at five different compound concentrations. We calculated the number of differentially expressed genes observed for a given cell line exposed to pairs of compound concentrations, across all compounds. The data from the K562 cell line revealed that out of the 188 compounds studied, 39 of the compounds elicited a significant differential gene expression response in at least 10 genes, suggesting the concentrations of compounds tested was physiologically appropriate for this subset of compounds. These 39 compounds cover approximately 20 classes of compounds. HDAC inhibitors seemed to be the most prevalent of these 20 classes identified.
Resume Scanner is a program that extracts personal information about a person based on what they had put on their resume using the OCR and ML approach. Resume Scanner is intended to be used by company recruiters who need to process thousands of resumes for every set of job positions. It offers an automated method for recruiters to selectivity filter out resumes that do not meet the job requirements. The product is fast, free, and able to handle even resumes in formats that are out of the industry norm. Furthermore, Resume Scanner's source code is open source, and the personal information extracted from each resume is programmed to save into a MySQL database the user indicates they owned. In other words, Resume Scanner's users can tailor the product's source code as they see fit, and use the product as part of the back-end of their large-scale application.

Target LRU Assembly Fixture

The Lawrence Livermore National Laboratory (LLNL) is a research facility funded by the federal government. One of the many laboratories at LLNL is the National Ignition Facility (NIF). NIF holds the world's most powerful laser with the purpose of achieving nuclear fusion through laser energy. The laser is used for hundreds of experiments per year. Many experiments require cryogenic temperatures. These experiments require fitting the sample (called the target elsewhere in this report) onto an ignition target inserter cryostat (ITIC). The ITIC holds the target in place during the experiment and provides cooling, and thermal isolation. With current procedures, target installation can take anywhere from eight to twelve hours limiting the number of experiments (called shots) that can be conducted per day. As part of an attempt to increase shot frequency, NIF engineers are designing a target line replaceable unit (LRU) that only requires one to two hours of inline installation time. For this new procedure, the LRU is assembled and prepared in an offline facility reducing inline installation time dramatically. This project provides a design for an LRU assembly fixture. This fixture provides a safe environment for target installation onto the LRU as well as holding the target for optical quality assurance (QA) procedures.

The objective of this project is to aid clinicians in handling the increase in use of the prone position due to the COVID-19 pandemic and limit the occurrence of pressure related injuries in COVID-19 patients in the prone position. Our aim is to develop a device that is durable, autonomous (reliable without the need for continuous check up), cost-effective and able to alleviate pressure over long periods of time, especially in the facial regions. Through our aim, we hope to help not only clinicians but any personnel who is dealing with COVID patients and respiratory illnesses. The assumptions associated with the use case of our device is that the adult patient is sedated, intubated, and proned for an extended period of time.
Bioengineering Senior Design Project

Michael Puso
Major: Aerospace Science & Engineering and Mechanical Engineering
Mentor: Dr. Case van Dam
Research Type: Engineering Design Project

Effect of Shape and Orientation on the Thermal Performance of Greenhouses in the Western USA

Crop production in a controlled environment setting in Mediterranean regions has become popular due to the increased negative impacts of climate change. However, the greenhouse energy costs, especially the costs for heating and cooling, depend heavily on the greenhouse’s shape and orientation. Previous studies recommended various shapes and two different greenhouse orientations for greenhouse all over the world. A quasi-steady state thermal model known as GREENHEAT was developed to simulate conventional greenhouses’ hourly heating requirements over a year. Currently, GREENHEAT model does not address the transient air turnover rate due to ventilation in the greenhouse, which could significantly affect energy-demand, especially under cooling mode. To account the effect of varying air exchange, the study will create a ventilation sub-model to simulate the required ventilation to control the temperature and relative humidity in the greenhouse. This study aims to analyze the effect of five different greenhouse shapes and orientation on energy costs in three climates representing major agricultural regions in California.

Anika Varma
Major: Chemical Engineering and Biochemical Engineering
Mentor: Dr. Karen McDonald & Dr. Somen Nandi
Research Type: Engineering Design Project

Bioprinting transgenic plant cells for production of a recombinant biodefense agent

Transgenic rice cells (Oryza sativa) producing recombinant butyrylcholinesterase (BChE) as a prophylactic/therapeutic against organophosphate nerve agent poisoning, cocaine toxicity, and neurodegenerative diseases like Alzheimer’s were immobilized in a polyethylene glycol-based hydrogel. The cells were sustained for 14 days in the semi-solid matrix, undergoing a growth phase from days 0-6, a BChE production phase in sugar-free medium from days 6-12, and a growth/recovery phase from days 12-14. Throughout this period, the cells maintained similar viability to those in suspension cultures and displayed analogous sugar consumption trends. The rice cells in the bioprintable hydrogel also produced a significant amount of active BChE, comparable to the levels produced in liquid cultures. A considerable fraction of this BChE was secreted into the media, allowing for easier product separation. Overall, we demonstrate a simple, efficient, robust, modular, and potentially field-deployable bioreactor system for the manufacture of biologics. This project provides a design for an LRU assembly fixture. This fixture provides a safe environment for target installation onto the LRU as well as holding the target for optical quality assurance (QA) procedures.

Nichole Yacoub
Major: Chemical Engineering
Mentor: Dr. Jason White
Research Type: Engineering Design Project

Sustainable Production of Isopropanol and Acetone Using Propane

Isopropanol and acetone are industrially significant chemicals with a wide variety of applications, such as in chemical solvents, pharmaceuticals, and personal care products. The emergence of the COVID-19 pandemic led to a surge in isopropanol demand in particular as hand sanitizers and cleaners sales peaked. Currently, both chemicals are derived from the indirect catalytic hydration of propylene, which is a key product of the petroleum refining process. Unfortunately, the shift towards shale gas production has led to a sharp reduction in propylene availability and a consequential rise in its market price. Thus, an opportunity has been identified to select a cheaper feedstock, propane, to increase isopropanol and acetone abundance and reduce the cost of the products in which they are used. This engineering design project presents a two-step process in which propane is partially oxidized to an acetone-rich mixture of acetone and isopropanol in the presence of a Au/TS-1 catalyst, which is then further oxidized in the presence of a Cu-Al catalyst to improve isopropanol selectivity. An advantage of this process is that it may be adjusted on-site to achieve flexible ratios of acetone/isopropanol production rates, reaching a total of 40,000 tonnes each operating year (335 days). As work on this design simulation continues, plans for carbon dioxide capture and efficient use of cooling and heating streams within the plant will hopefully result in a profitable, environmentally-conscious process.
Danielle Baza  
Major: History  
Minor: Native American Studies  
Mentor: Dr. Greg Downs  
Research Type: Honors Thesis in Major  
California Fever: Madness in Gold Rush Era California  
The development of California’s mental institutions coincided with the birth of a new state, one that blossomed out of disarray and in face of a sudden influx of people. Nineteenth century popular culture and doctors defined “insanity” in extremely ambiguous terms, effectively construing mental illness as any behavior that disrupted society. Through the lens of writings by Dr. Robert Reid, resident physician of the Stockton State Hospital, my work examines one perception of mental illness and the way that California’s approach to mental health created an atmosphere of instability for newcomers to the state. The quickness in which California transformed from being newly ceded and sparsely populated land from Mexico to a state with an ever-increasing population meant that California’s rudimentary legislature had no time to form a contingency plan tailored to the needs of its populace. The unique social settings in gold country, with the lack of the nuclear family and instead, the prevalence of homosocial camps with men of different ethnicities, threatened the fragile morality of the new state. California doctors and legislative representatives institutionalized social outcasts prone to drunkenness or dissipation, or because of religious fervor or unemployment, with the intent to reform them.

Vanessa Cardona-Ocegueda  
Major: English and History  
Minor: Chicano/a Studies  
Mentor: Dr. Maceo Montoya  
Research Type: UHP Thesis  
Fragments: Living as a Chicana Woman in the 21st Century  
In literature, Chicans/Latinx voices are still limited compared to the large amount of English/Western content we find. Fragments: Living as a Chicana Woman in the 21st Century is a collection of stories that attempts to document the struggles of young Chicana/o people as they come to understand how their experiences, their culture, their language, etc. may intersect and affect their identity. Fragments follows the life of a young Chicana woman as she tries to come to terms with how her identity as a “Mexican-American” complicates her relationship with her family and other relationships she forms. This work attempts to expand the scope of available Chicana/o literature by using Chicana/o narrative forms. The work builds on previous understandings of Chicana/o identity but adds reflections of 21st-century scholarship and social norms. The work is largely autobiographical in content so the hope is that this narrative will help expand other people’s interest in documenting their own narratives so there are more Chicana/o voices in literature.

Victoria Beck  
Major: Mathematics  
Mentor: Dr. Laura Starkston  
Research Type: Honors Thesis in Major  
Relations on the Mapping Class Monoids of Surfaces  
The mapping class group of a surface is a set of functions which continuously bend and stretch the surface, called homeomorphisms. In the mapping class group, two homeomorphisms are considered to be equivalent if they are isotopic to one another. Furthermore, homeomorphisms of the annulus that fix the boundary pointwise are called Dehn twists, and products of Dehn twists along simple closed curves in any surface generate the entire mapping class group of that surface. Using the swing presentation, Margalit and McCammond have previously defined a complete set of relations on the mapping class group. In this project, we consider the elements of the mapping class group that can be generated only by positive Dehn twists, which form the mapping class monoid. We aim to define new relations on the mapping class monoid of a genus 0 surface in order to determine when two elements are equivalent. This information can be used to analyze Lefschetz fibrations, which build 4-dimensional spaces with boundary using surfaces together with products of positive Dehn twists around simple closed curves. In particular, the boundaries of two Lefschetz fibrations are homeomorphic if their associated products of Dehn twists are equivalent in the mapping class monoid.

Trevor Carpenter  
Major: Computer Science and Statistics  
Mentor: Dr. Setareh Rafatirad  
Research Type: UHP Thesis  
U.S. 2020 Twitter Analysis: A Knowledge Extraction of Events and Public Reception  
In the age of social media, Twitter is a medium for the everyday person to not only voice their opinion on large topics, but also connect with and influence thousands as a result. In 2020, a year of elections, lockdowns, and vast differences of opinion, Twitter was ranked 4th in the world for engagement as external influence through social media resulted in historical events that weren’t all positive. In this research we utilize Machine Learning and Data Science techniques to analyze tweets throughout the year and visualize their correlation with large events and public reception. The project emphasizes the use of algorithms for the purpose of finding what influences people, whether that is classifying harmful bots that spread misinformation or analyzing text sentiment to quantify the attitude of users. The research is currently in progress, but preliminary results suggest a strong polarization of opinions throughout the year, as well as an increase in misinformation spreading Twitter bots. Our goal is to use this research to warn about the harmful influence of social media in polarizing people’s opinions on political topics.
So often transgender individuals are burdened by improperly used generalizations, subject to discrimination and prejudices arising from deeply rooted transphobia, and characterized by negative health outcomes (e.g., HIV risk) that affect them disproportionately but do not define them. I investigated personal testimonies and contextual information from media and published academic sources to capture the perspectives and stories of the transgender communities in Mexico and Peru. Society too often focuses on numbers and statistics, overlooking the human element of marginalized populations, so sharing the voices and aspirations from within those communities is key for social progress. By using the insight of those directly impacted by social injustice, allies of the transgender community and social activists in general can create broad alliances and develop effective campaigns targeting both the root causes and the various manifestations of social injustices. Specifically, for the transgender communities in question, efforts must increase the visibility and appreciation of transgender individuals across society, prevent the continued pathologizing and stigmatization of different gender identities, and move on from narrow perceptions of gender based on binary concepts that fail to reflect the natural diversity of humanity.

The drug family known as statins are inhibitors of hydroxymethylglutarate-CoA Reductase (HMGR) enzyme in humans. HMGR Reductase is responsible for catalyzing the committed step in cholesterol biosynthesis. Inhibiting HMGR via statins has shown to reduce cholesterol levels in individuals with hypercholesterolemia. This study derives two novel small molecules by evaluating four commonly prescribed statins - simvastatin, atorvastatin, fluvastatin, and rosuvastatin. A library of structural conformers were created for each small molecule and were docked into the active site of HMGR in humans and given a docking score. Among these four inhibitors, fluvastatin exhibited the strongest binding effect with a score of -12.46. From this result, fluvastatin was designated as the lead molecule and two new molecules were designed from it using computational and hypothetical methods. Preliminary results of these newly designed drugs produced marginally better docking scores of -14.29 and -13.34 respectively. Slight changes in ADMET properties in the new molecules were also observed, as well as minor improvements to drug-enzyme interactions, likely resulting in the improved docking scores over the lead molecule. Future work will improve upon these scores and explore how Single Nucleotide Polymorphisms (SNPs) may affect inhibitor binding.
Emotion regulation (ER) refers to the capacity to monitor, evaluate, and manage one's emotions and physiological arousal to meet the demands of an activity or accomplish a goal. Within a classroom environment, students are expected to maintain an optimal state of physiological arousal to engage in learning. Although students often utilize an array of self-regulatory behaviors to help stay well-regulated, such as rocking or standing, classroom seating is typically not designed with this in mind. For instance, a student who benefits from vestibular sensory input cannot easily rock their four-legged or attached-to-desk chair. To help students meet their regulatory needs, this project focused on designing a desk that is adaptable to promote self-regulation, focus, and executive function skill development in students with varying learning needs. The first step included conducting a comprehensive review of the literature on ER across populations and stages of development and exploring options for flexible classroom seating. Next, K-12 and college students, teachers, and parents volunteered to complete a 10-question survey to gather input on their seating preferences. The literature review and survey data were then used to inform the design and development of a "sensory friendly" desk for K-12 classrooms.

Since its founding in October 1923, The Walt Disney Company has endured as an influential preserver of fantasy, traditional American values, and folklore. As a company created to entertain the masses, its films often provide a sense of escapism as well as feelings of nostalgia. The company preserves these sentiments by "Disneyfying" danger in its media to shield viewers from harsh realities. Disneyfication is also utilized in the company's responses to cultural shocks and tragedies as it must carefully navigate maintaining its family-friendly reputation, utopian ideals, and financial interests. This paper addresses The Walt Disney Company's responses to two attacks on US soil: the bombing of Pearl Harbor in 1941 and the attacks on September 11, 2001 and examines the similarities and differences between the two. By utilizing interviews from Disney employees, animated film shorts, historical accounts, insignia, government documents, and newspaper articles, this paper analyzes the continuity of Disney's methods of dealing with tragedy by controlling the narrative through Disneyfication, employing patriotic rhetoric, and reiterating the original values that form Disney's utopian image. Disney's responsiveness to changing social and political climates and use of varying mediums in its reactions to harsh realities contributes to the company's enduring reputation and presence in American culture.
**Xander Guldman**  
Major: International Relations  
Mentor: Dr. Jonathon London  
Research Type: UHP Thesis  

**Water Shortages, Lithium Mining, and The Indigenous Community in San Pedro de Atacama The Impact of Profit Maximizing Behavior on Atacameño Tradition**

To many, electric vehicles symbolize an important step toward an environmentally sustainable future. The lithium used in EV batteries, however, carries a heavy social cost. The water intensive process by which lithium is mined has rapidly depleted the water table in Chile’s Atacama desert, which is home to the most extensive lithium reserves in the world as well as the indigenous Atacameño people. This paper seeks to understand the impact that lithium extraction has on the indigenous population of San Pedro de Atacama, and how water is managed in this fragile ecosystem. Videos of panel discussions, news articles, academic literature, and social media pages were analyzed to shed light on the above topics. Findings emphasize that water shortages are causing irreversible cultural damage to the Atacameño community. Economic motivations at the state and corporate levels guide how water is managed and distributed in the interests of national and global capital in ways that interfere with intergenerational traditions.

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**Oceana Haaland**  
Major: Political Science  
Minor: Geology and Human Rights  
Mentor: Dr. Daniel Kono  
Research Type: Honors Thesis in Major  

**Increasing Climate Action: Social Welfare Spending and Climate Change Opinion**

Climate change is one of the most important issues facing the world, yet public opinion towards climate change varies across countries. Why certain publics are more supportive of climate action than others is an unanswered question within political science research. In this article, I examine the role of social welfare on climate public opinion by comparing state social expenditures and aggregate public opinions across different countries. I hypothesize that voters who may be negatively impacted by environmental regulations are more likely to support those policies and believe climate change is a threat if they are socially protected through welfare systems and unemployment benefits. I test my hypothesis by comparing state social expenditures and unemployment spending to aggregate public opinions through a cross-national analysis. Through regression modeling I find my results to be generally supportive of my hypothesis, that constituents of social welfare states are more likely to be in favor of climate action legislation because they are compensated for the negative impacts that those policies may have. Thus, my research may offer increasing social welfare benefits as a potential solution to increasing positive public opinions towards climate change, and perhaps environmental policy.

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**Michael Gutierrez**  
Major: Spanish  
Minor: Education and Public Health Sciences  
Mentor: Dr. Eddy Ruiz  
Research Type: UHP Thesis  

**Counterstories of Honors Students of Color**

This project aims to explore and document the experiences of high-achieving students of color in university honors programs. The methods utilized in this research are both quantitative and qualitative in nature, with 5 interviewees of color being selected from a pool of about 40 survey participants. The results indicate that a majority of interview participants agreed that more diversity and representation was needed in honors, and that it was often difficult to find a community of people within honors who understood and could relate to their racial/ethnic, cultural, and/or socioeconomic backgrounds. Numerous participants recalled almost dropping out of honors altogether, and many experienced feelings of racial tokenization, alienation from peers, and impostor phenomenon. Overall, the findings elucidate the pressing need for university honors programs to recruit more students from underrepresented backgrounds and to provide targeted resources to support these students in developing a sense of community and belonging within honors.

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**Sabrina Habchi**  
Major: Political Science and Psychology  
Minor: Sociology  
Mentor: Dr. Erik Engstrom  
Research Type: Honors Thesis in Major  

**American Politicians of Middle Eastern Descent: Examining Voter Assessment of Competence**

Middle Easterners in the U.S. are often referred to as America’s invisible minority, since they are marked by the U.S. Census as Caucasian, but often do not benefit the same way as those of European descent. In fact, despite the complexities of Middle Easterners’ ethnic and racial compositions, individuals within this racial group are often characterized as Muslim even when this may not necessarily be the case, which may further affect how Middle Easterners in the U.S. are treated given the present day’s hostile political climate towards Muslims. This study will examine whether women of Middle Eastern descent who run for political office in the U.S. are appraised differently by voters in terms of competence than white women and men who run for office. This will be assessed by presenting participants with hypothetical candidates, including a small statement and picture, of either a white man, white woman or Middle Eastern woman and assessing their responses in regards to believed competency and willingness to vote for this candidate. Participants in each condition will be given the exact same information about the candidate, with only the name, sex and racial background manipulated.
The California State Legislature is one of the most influential policy chambers in the country. California has 40 million citizens and is the 6th largest economy in the world. Being an effective legislature in the California State Legislature makes the decisions made in Sacramento very important surrounding the Cold War in Southeast Asia and the lives it uprooted, barely seemed to get a passing mention. Combining historical research, personal interviews, and my own knowledge, I created a short narrative documentary of how my father’s family escaped the Cambodian Genocide and came to America, accompanied by a historical prelude. When the Khmer Rouge under Pol Pot defeated the Cambodian monarch and government forces, they began a long campaign to create a nationalist agrarian communist “utopia” by murdering and displacing millions. In the chaos, my father’s family, alongside the rest of the urban populace, were forced to march to the countryside and jungles to resettle. From their small drug store to the perilous jungles of Cambodia, the documentary details my father and his family’s memories of how they escaped the Cambodian Genocide, and eventually came to settle in the United States.

Many theorists have suggested that the early perceptual processing of emotional faces could play a role in the later understanding of emotions and other mental states. However, research exploring this relationship has been lacking. Previous research has highlighted the preschool years as an important period of development for theory of mind (ToM), the ability to understand and reason about others’ mental states. The present study aims to explore the connection between theory of mind and emotion perception in preschool children. We recorded electroencephalogram (EEG) data while participants viewed emotional faces and used the modulation of the N170, a face-sensitive event-related potential (ERP) component, as a measure of emotion perception. We assessed ToM via two measures: the Simplified Eye Reading Test (SERT), which asks children to determine emotional state based on pictures of eyes, and Wellman and Liu’s mental state reasoning task battery (2004). We hypothesize that greater N170 modulation in response to emotion will correlate with greater ToM scores on both measures and that the correlation will be stronger with mental state decoding (SERT) than with mental state reasoning. The results could provide insight on emotion perception as a precursor of ToM and into differences between subcomponents of ToM.
Laura Jett
Major: Cognitive Science
Minor: Psychology
Mentor: Dr. Tamara Swaab
Research Type: Honors Thesis in Major
Effects of depression and anxiety on negative word processing

In the face of rising depression and anxiety, as well as unresolved questions from past research on cognitive bias in these disorders, this study aims to examine how depression and anxiety affect the processing of words with a negative meaning (e.g., grief). Specifically, I will compare participants across the spectrum of depression and anxiety on how they process negative vs. neutral words on measures of attention (emotional Stroop task), implicit memory (word naming), and explicit memory (recollection task). I will also evaluate potential modulating factors such as stimulus self-relevance and performance on a classic Stroop task. Prior literature suggests that while we may see attention and memory bias towards negative words overall for both anxious and depressed individuals, we may expect an even greater attention and memory bias towards negative words in these individuals for disorder-specific, self-relevant words. Such a finding would be important because negativity bias has been implicated as a risk factor for anxiety and depression. By comparing depression-related, anxiety-related, and uncategorized negative words, and by evaluating stimulus self-relevance, this study can assess whether there is bias towards negative information more generally, or if the bias is disorder-specific, which may have implications for future research and interventions.

Gursimran Kaur
Major: Political Science and Gender, Sexuality, & Women's Studies
Mentor: Dr. Rana Jaleel
Research Type: UHP Project
Gender Equity Podcast

Intersectional feminist spaces can often be difficult to navigate without prior knowledge of power dynamics caused by issues of race, class, gender, sexuality, disability, and more. Yet, in a contemporary sociopolitical climate that centers a need for social justice work, it is necessary to bring people into conversation who would otherwise not be involved in feminist discourse. This project seeks to create a resource for people hoping to enter feminist communities and build knowledge on introductory concepts in intersectional feminist thought. The goal is to create a resource in the form of a podcast by engaging in conversations with people doing gender equity and social justice work in the Davis community as well as professors who are doing scholarship on feminist topics. By making these often daunting ideas and conversions more accessible, the hope is that more people will feel empowered to enter feminist spaces and engage in very necessary social justice work.

Michael Johnson
Major: History
Mentor: Dr. Lisa Materson
Research Type: Honors Thesis in Major
The Changing Legal and Social Definitions of Consent Between the 1980s and 2008 For Sex Crimes in the U.S. Justice System

The United States justice system is home to many errors and is subject to improperly written laws which not only negatively affects its citizens but makes it difficult for courts to interpret the law. One of those many errors is the changing definition of consent over time, specifically between the 1980s and 2008. My study examines the changing definitions of consent from the time of slavery in seventeenth century well into the twenty-first century to see how it affects court proceedings involving sex-related crimes. This study also looks at how these legal ambiguities surrounding the changing definitions around the U.S. may affect people of color accused of sex crimes, how it may lead to an improper conviction in the eyes of the law, and how that may pose a risk to other people who are accused of crimes of the similar nature.

Tamia Landers
Major: Sociology and Psychology
Mentor: Dr. Jacob Hibel
Research Type: Honors Thesis in Major
Pandemic Homeschooling: How Will This Impact Children?

During this unpredictable time of COVID-19, there have been many sudden changes, some of which being related to the educational systems. Many schools have shut down for the remaining months of the 2019-2020 academic school year, and will continue to operate online as children progress through the 2020-2021 academic school year. Children are essentially being forced into homeschooling, which may leave some children falling behind in their school work. This qualitative research study explores children's educational progress and achievement as well as problems that the families face in their day to day lives in relation to the struggles brought on by COVID-19. This study involves semi-structured interviews, three per family, of four families in the US with elementary school aged children through a case study approach on the topics of educational progress, behavior, and access to resources, comparing before and after the pandemic. The findings of this study will be able to provide insight on the benefits and downfalls of education during the pandemic, highlighting issues that families and schools can work on.
Affinity of SARS-CoV-2 Spike Protein Fragment to Heparin

This research aims to determine the binding affinity of a SARS-CoV-2 spike protein fragment to heparin through computational methods. Recent research suggests that the glycosaminoglycan heparin which is also present in most mammalian cells may be able to bind to the SARS-CoV-2 spike glycoprotein, explaining observed lower transduction efficiency in cell culture when high amounts of heparin is present. To validate this interaction, a SARS-CoV-2 spike glycoprotein fragment and heparin are tested in silico to find binding affinity by measuring the relative distances between the molecules at various time points. Hydrogen bonding interactions between the two molecules are also mapped for better understanding of the interaction. Preliminary results in the form of a mean square displacement graph demonstrate that there has been a conformational change in the spike protein fragment induced by heparin. Data is currently being generated to map the hydrogen bonding network that exists between the spike protein fragment and heparin. High binding affinity may reveal potential in heparin and its derivatives as drugs to reduce transfection rates of SARS-CoV-2.

Social Compensation or Augmentation: Social Media Usage Augments Bicultural Individuals’ Acculturation Stress and Bicultural Conflict

The popularity of social media sites and apps has stimulated research on how its habitual use is linked to increases or decreases in social capital, loneliness, and well-being. However, there is less research on how bicultural individuals use social media to navigate their belonging to two or more cultural groups. In particular, bicultural conflict describes the degree to which individuals perceive tension between their two identities. It has been correlated with their ability to shift between cultural lenses, acculturation stress, social network diversity, and mental health. An Mturk survey sample (N = 721) was recruited to explore the link between social media use, acculturative stress, and bicultural conflict. Path analyses indicated that, among bicultural individuals, intensity of social media use was positively associated with acculturation stress factors such as increased language skill difficulties, race-related work challenges, perceived discrimination, intercultural disagreements, and cultural isolation. In turn, these factors were associated with increased bicultural conflict. Social media use was also directly linked to increased bicultural conflict. The results supported the social compensation hypothesis as they imply that bicultural individuals employ social media more intensely to cope with societal pressures but in doing so, experience increased acculturation stress and bicultural conflict.

Computational Simulations of SARS CoV-2 spike proteins with antibodies with estimates of binding energies and potential antibody escape

The worldwide outbreak of SARS CoV-2 has highlighted the issue of achieving reliable binding of manufactured proteins to individual virus particles (virions) both for capture (in detection) and neutralization (in therapeutics or prophylactics). Computational physics tools such as molecular dynamics programs can be used to test binding affinities of amino acid polymers with the Covid spike protein in order to predict how effectively mutant strains will bind to proteins in vivo, or how effectively synthesized polymers can neutralize the Covid spike protein (and its mutants). Furthermore, these computational simulation tools can be used to predict how SARS CoV-2 will escape from antibodies produced in response to infection or inoculation, thus allowing us to understand how and why mutant strains such as the Brazil, South Africa, or UK strain escape from antibodies and increase infectivity. This will also allow us to prepare for not yet existing mutant strains by running simulations on edited proteins to determine if their binding affinities increase or decrease (mutated mutants with higher binding affinities could potentially evolve if such mutations do not impact the protein’s function). Here, we use molecular dynamics programs such as YASARA to run simulations and gather information about hydrogen bonds and estimated binding energies, in addition to HawkDock, a server-based protein-protein binding energy estimation algorithm.
The emergence of political polarization has been of great interest to many scholars in the humanities and social science field because of its impact on modern society's social cohesion. Mass media is a critical point of study because of its informative role in society and its capability to provide a platform to elite figures who could be driving the phenomenon. Thus, it has the ability and has proven to favor one party or ideology over another. Nonetheless, we can understand political polarization as the diverging of political attitudes to ideological extremes. This topic is usually discussed in the context of partisan polarization of Republicans and Democrats and democratic government systems. As a result, studies show that polarization can have negative consequences for democracy, political attitudes, mass opinion and mass consent, and even the personal lives of the mass media audience. This project attempts to outline and analyze essential findings in this area and provide proposed solutions for this growing issue.

In 2017, an anonymous user began posting on the online image board 4chan, alleging conspiracies involving partisan politics and public figures in the U.S. These posts evolved into QAnon, a conservative movement founded on a complex web of conspiracy theories. Since the FBI classified QAnon a domestic terrorism threat in 2019, evident in its visibility at the insurrection on the U.S. Capitol, QAnon has gained footing in over 70 countries and garnered international media attention. Speculation into QAnon's origins and rapid spread prompts many questions, namely why did the movement arise and captivate millions of Americans?

My research undertakes these questions from a historical perspective. By contextualizing QAnon and its ideas about religion, race, patriotism, gender, and politics in U.S. history, I demonstrate that the movement is a new rendition of old beliefs and anxieties co-opted and applied to present-day society. In particular, I examine well-documented histories of fundamentalist and evangelical Christianity, white power movements, and the politicization and weaponization of conspiracy theories. I argue that QAnon and its ideologies are extremist variants of more "mainstream" elements of the New Right in the U.S. during the twentieth century.

Neutrophil elastase (NE) is a pro-inflammatory serine protease secreted by neutrophils, the most common type of white blood cells. Many studies have linked high NE activity to lung diseases such as Cystic Fibrosis (CF), bronchiectasis, Chronic Obstructive Pulmonary Disease (COPD), and Acute Respiratory Distress Syndrome (ARDS). Research has shown that inhibiting NE can lead to improved outcomes in patients with these diseases. Currently, there is only one small molecule NE inhibitor on the market, Sivelestat, though several others are in clinical trial. Sivelestat has had mixed success, and must be administered intravenously. We use computational methods to develop a novel small molecule inhibitor of NE with improved efficacy, and that could be administered orally or inhaled. A molecule library of drug candidates and their conformers was generated, then docked of the small molecule into the active site of the enzyme. Additionally, we will test the binding of the inhibitor on a different variation of the enzyme, to ensure efficacy in different populations. This work will potentially generate a novel drug candidate for pre-clinical trial to treat various chronic and acute pulmonary diseases.
Infographics and Smoking Cessation among Adolescents Plan
Throughout the past couple of decades, there has been an increase in smoking of certain age groups. This can be caused by a variety of reasons, but the most impactful is peer pressure and societal norms. The age group that I am targeting ranges from 18-25-year-olds. According to the Centers for Disease Control and Prevention (CDC), 9 out of 10 adults that smoke regularly had their first cigarette around the age of 18, and 99% of those adults have tried a cigarette by the age of 26. The goal for my project is to create an infographic that informs populations and youth that smoking is not the norm and to avoid societal pressures with an ultimate objective of decreasing smoking intentions and increasing smoking cessation. Using the Theory of Planned Behavior and Theory of Reasoned Action, I have created several persuasive graphics that rely on theoretically driven appeals in order to prevent smoking behaviors or cease smoking among the target audience. The theories have taken into account various factors that will influence one to engage in a behavior, specifically smoking cessation and avoid smoking, for my project. I have focused my research prominently on two factors: subjective norms and perceived behavioral control. The infographics I have designed are modeled after these theories and factors. I will test the effectiveness of these persuasive appeals through Instagram and Twitter and review the reactions of the targeted audience.

The Social and Cultural World of the Overland Trails
Over 250,000 people traveled west on the Overland Trail during the mid-nineteenth century. This large number of emigrants moving westward in search of fortune and farmland meant more opportunities for interaction than previously available in the daily lives of Midwest farmers, especially for women. As overlanders rode in wagons westward, they carried their culture with them while embracing the freedom and flexibility offered by trail life. Building on the work of historians who have emphasized the distinct experiences of men and women and gendered divisions of labor on the Overland Trails, I examine the social life of overlanders to better understand how migration impacted their friendships and romantic relationships, as well as how they worshiped, celebrated, danced, and played. My research examines the emotional and relational nature of crossing the plains, the transmission of tradition and culture, as well as newfound freedom in the mobility of the trail. Based on analysis of women’s overland trail diaries and memoirs spanning from 1840 to 1865, I demonstrate the importance of culture and connection in crossing the continent.

We Are Dying to Be Heard: Examining News Coverage of Asian Americans During the COVID-19 Pandemic
“We are dying to be heard,” cries activist Amanda Nguyen in a video highlighting another video where 84-year-old Vicha Ratanapakdee is fatally pushed to the ground by a passing assailant. How do mainstream and ethnic news frame Asian Americans during the COVID-19 pandemic with increasingly reported anti-Asian hate crimes and George Floyd’s death tied with the Black Lives Matter movement? How do Asian Americans themselves speak out in the news, resisting or even capitalizing on certain stereotypes? Using a historical and textual analysis, I examine several online news articles covering key events related to the Asian American community from the most credible mainstream news outlets, including NBC News, ABC News, and Fox News. I also compare these articles with those covering the same key events from Next Shark, an Asian American ethnic news outlet. I posit that the yellow peril and model minority stereotypes are framed in mainstream media as a counterscript in the wake of George Floyd’s death and Thau Thau’s role. I also look at the gendered representations of Kellie Chauvin and the Atlanta spa shootings. I further question the impact of Asian Americans as producers of news/media on the representation/visibility of issues, highlighting the controversial roles of specific celebrities/figures such as Daniel Dae Kim and Andrew Yang. I indicate the need for further research on news coverage of Asian Americans during the pandemic and the lived impact on the community.
Video Game to Teach Introductory Programming

Programming can be a difficult skill to learn for many undergraduate college students. However, learning to code can be extremely useful and beneficial to know for a number of fields, to aid with data analysis and visualization in those fields. Additionally, computational thinking is helpful for a better understanding of many of the technologies we use on a daily basis. In order to aid this learning, I chose a game as my medium because it has a high potential to motivate students and provide a good learning environment. I designed and began developing this video game to teach coding in the R programming language to non-computer science majors. While there are existing games that teach coding, I identified aspects in each that detract from their educational effectiveness. A majority have been made for a different audience than undergraduate college students, and have design choices that are profit-motivated instead of educationally motivated decisions. I then designed my game based on research-backed educational and game design principles which I identified and recorded in a literature review and evaluation of existing games. The game is expected to improve students’ learning of introductory programming skills and principles, with an emphasis on data science concepts.

Evaluating Cultural Destruction: Jurisprudence through Criminal Response, Restorative Response, and Regulatory Process Perspectives

Cultural heritage has a tenuous relationship with international humanitarian law. This thesis assesses the current state of international legal structures that exist to protect cultural heritage during armed conflict and formulates why cultural destruction should be treated as a consequential human rights issue. I lay out the role and theory of cultural destruction in key human rights legal concepts such as Crimes against Humanity and Genocide, and how these concepts are incomplete without including the destruction of cultural heritage. I use three approaches—the criminal response, the restorative response, and the regulatory process—to evaluate existing cultural destruction jurisprudence. In the criminal response section, I analyze the International Criminal Court’s role in protecting cultural heritage. I utilize The Prosecutor v. Ahmad Al Faqi Al Mahdi, the first case in which the ICC imposed a sentence for attacking cultural heritage, and other cases undertaken by International War Crimes courts to conceptualize this approach. In the restorative response section, I explore post-Holocaust legal restitution efforts for looted cultural property, the restoration of built cultural heritage in the aftermath of destruction in cases such as Mali, and post-conflict efforts in countries like Syria to preserve cultural heritage. Finally, in the regulatory process section, I explore how cultural heritage can be conceptualized as matters of property law, repatriation, and nationally focused litigation and legislative efforts to protect cultural rights. Most significantly, I utilize the Native American Graves Protection and Repatriation Act as a case study to explore the protection of indigenous cultural property rights.
Janelle Salanga  
Major: Science & Technology Studies  
Mentor: Dr. Lindsay Poirier  
Research Type: Honors Thesis in Major  
Building Media for Revolution

The priorities of media and the way that communities of color have been covered have both long been dictated by white folks, resulting in the furthering of harmful stereotypes. Because access to institutions that lend credibility to community story-telling — namely, academia and media outlets — has been limited for communities of color, mainstream historical narratives and newspapers offer non-nuanced portrayals of Philippine-American issues. The barrage of images of Black death, immigrant detention, and government irresponsibility on social media engenders feelings of helplessness and hopelessness, rendering people unsure about actions they can take to fight against injustice in their communities. Consequently, this project — a series of workshops put together over the span of two quarters — will teach students about basic journalism frameworks and skills, in order to help folks become comfortable with talking to others in their community, understand the types of information (e.g. public records) available to them, and get used to doing independent research. It will provide space to build collective understanding around social structures and phenomena like racial capitalism and imperialism, while looking at the way those phenomena manifest in the Philippine diaspora and in the Philippines itself.

Chloe Thepenier  
Major: Design  
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Research Type: Honors Thesis in Major  
Dear Sister

Inspired by the analog information design Dear Data project by Giorgia Lupi and Stefanie Posavec, Dear Sister consists of an analog infographic exchange between a Graphic Design student in the United States and her sister, an Aerospace Engineer in France with a Master's Degree in Astrophysics. The main goal of the project is to explore ways to convey information related to space and space exploration efficiently in a restricted postcard format, through ten different topics. Personal reflections and processes are recorded through journaling and documenting. A more thorough analysis will include interviews of the postcard makers regarding the challenges they encountered and their takeaways, a visual analysis and comparison of the postcards, and interviews of several participants from the general public to evaluate the objective of clearly conveying information. A preliminary hypothesis based on the first two postcards suggests that while derived from the same data, the interpretation and prioritization of certain elements can differ depending on the maker, creating distinct narratives. Further analysis will assess the extent of these variations and the potential impact of personal bias and organization preference on information design layout and overall visual communication. A website will share the results with a wider audience.

Mikka Vapor  
Major: International Relations and Economics  
Minor: French  
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Research Type: UHPT Thesis  
Neo-Imperialism and the Cold War Legacy of the 21st Century: Analyzing the Triangular Relationship Between the United States, the Philippines, and China

This research examines the long-standing "special" relationship between the Philippines and the U.S. as it has developed and evolved from its colonial and imperial relations of the past. Despite the Philippines’ granted sovereignty, the U.S. still has close political, economic, and military ties with the Philippines, maintaining its large influence over the Philippines in its global economic and military presence. Focusing on the various international agreements including the Visiting Forces Agreement, the 2014 Enhanced Defense Cooperation Agreement, and other international policy proposals, I argue that the neo-imperialistic relationship of the U.S. and the Philippines has been maintained through their current international relations. I also address that the U.S. has attempted to draw the Philippines closer in their superpower rivalry with China, reflecting an ongoing Cold War legacy in the Asia-Pacific. By using a mixed methodology approach that includes Fairclough's (1992) Critical Discourse Analysis, Cultural Political Economy Analysis, and Foreign Policy Analysis, I demonstrate that the language of these international agreements and policies reveals the U.S.’ perspective and view of their role in the Philippines, the U.S.-China rivalry and their discussed actions towards these countries.
While it is well known that race is a major determinant of school choice, it is not known to what degree student racial composition matters when compared to other school factors. Because the tendency of parents to choose schools with populations that are ethno-racially similar to them results in de facto school segregation, it is important to understand if certain school characteristics can mitigate these patterns. In order to understand how race and non-racial school characteristics interact to impact school choice preferences of California parents, a factorial survey will be administered. School characteristics such as racial composition, academic performance, class size, and the existence of magnet programs will be independently varied and presented to participants as vignettes to evaluate. Results will illustrate whether certain school characteristics motivate parents to choose schools with populations that are ethno-racially different from them. If there are school characteristics that significantly impact parent preferences despite racial dissimilarities, these findings can inform school policies to encourage California parents to choose more ethno-racially diverse schools.

Photopharmacology is an emerging synergistic field of chemistry and biology that harnesses the power of light to render chemicals active or inactive with high spatial and temporal control. Photoswitches are amendable groups to a pharmacophore which enable researchers to toggle compounds "on" or "off" rapidly and reversibly. Azobenzene photoswitches are synthesized through an N-N bond forming reaction between aryl nitroso and aryl amino compounds known as a Baeyer-Mill's Coupling. Three outcomes are common after a Mill's reaction: desired product is formed, starting material remains unreacted, or an undesired byproduct, azoxybenzene, forms lowering the azobenzene yield. Here, the electronic effects governing reaction outcome were explored in order to predict and attenuate substrates' ability to form desired azobenzene. To accomplish this, differently substituted anilines were tested for their efficacy as azobenzene producing substrates. Calculated oxidation potentials for these anilines were then used as a proxy for predicting reaction outcomes. These calculations were then performed on substituted indoles which showed low azobenzene yields. Following our predictions, the electron-rich indoles' yields immensely improved through employment of labile protecting groups. Overall, these results demonstrate that substrates can be electronically manipulated to increase azobenzene yields and offers synthetic tools for researchers interested in studying photoswitchable compounds.

The use of non-human animals in biomedical research has long been a contentious topic amongst scientists, philosophers, and animal rights' activists. With 25 million vertebrate animals used for research each year, the question regarding animals' possession of a moral status has been an ethical dilemma. Amongst the various arguments regarding the issue of animals' moral rights, the Problem of Marginal Cases (PoMC) has been used by many animal advocates. The PoMC is an argument used to compare the moral status of certain persons such as infants, the severely mentally handicapped, and the comatose, to non-human animals. The PoMC explains that if such persons, unfortunately referred to as "marginal", are given moral consideration, despite their inability to meet the usual criteria of a moral status, then non-human animals should also be given such consideration. This paper investigates the use of the PoMC and its validity in the ethical discussion of animal research. Whatever conclusion is decided on may lead to the consideration of changes in the ethical treatment of non-human animals. Moreover, such changes could lead to drastic adjustments in the use of animals in research, if not the complete elimination.

Caregivers modify their actions when demonstrating objects to infants, known as infant-directed action (IDA). This study explores whether infants look longer at caregivers’ mobile gestures (with movement of the hand or arm) or stable gestures (without movement). I investigate if there are differences in infant looking time for gestures with small motions compared to large motions and whether monolingual and bilingual caregivers differ in frequency of gesture change. As most IDA research has been conducted in laboratory settings with manipulated gestures, I aim to examine naturalistic IDA through observing play sessions. 38 infant-caregiver pairs (19 monolinguals, 19 bilinguals) engaged in two tasks: free play and object-labeling. Interactions were recorded and coded for showing gestures, infant eye gaze, and caregiver language. I predict that (i) showing gestures with larger movements will be more effective at attracting and sustaining infant attention and, (ii) bilingual dyads will use gestures specific to bilingual input - they will switch or exaggerate gestures around a language change. Therefore, bilingual caregivers may show a higher frequency of gesture change and high amplitude gestures compared to monolingual caregivers, leading to longer looking times for bilingual infants. This research will aid in understanding the role of gestures on infant learning.