DU Undergraduate Showcase: Research, Scholarship, and Creative Works

Abstracts

Impacts of Ambient Air Pollution on Birth Weight Percentile and Gestational Age at Birth

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Research into early developmental periods has found that birth outcomes such as birth weight percentile and gestational age at birth are predictive of child development (Gutbrod et al., 2000). However, the research relating these birth outcomes with environmental factors such as maternal exposure to air pollutants remains relatively unexplored. Therefore, the current study examines whether exposure to air pollutants during pregnancy has an impact on birth weight percentile (BWP) and gestational age (GA) at birth. From a population of 272 mothers and children in the Denver area, no significant associations were found between child metrics and three types of pollutants (PM10, PM2.5, and O3), indicating that birth outcomes are not influenced by prenatal environmental exposures.

Point of Use Technologies to Increase Access to Clean Water in Rural Communities

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Access to clean water is an issue that many communities around the world struggle with. While large-scale efforts such as piping infrastructure have been successful, these are less effective at reaching small, rural communities. To supplement these efforts, point of use (POU) methods for water treatment can be implemented. These include boiling, chemical treatment, filters, and several additional technologies. These have all shown effectiveness in a lab setting, but their implementation in the real world, specifically in rural communities, has not been nearly as effective. In this paper, several different POU methods are evaluated for their effectiveness on a small-scale, including associated costs with each. A locally specific education campaign for the proper use of these technologies would empower individuals to treat their own water and be responsible for their own health in a way that has never been seen before.

Predicting Socioemotional Development Across the First Year of Life: Early Infant fNIRS and BITSEA

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Previous functional neuroimaging research on infant auditory vocal discrimination has found that infants demonstrate preferential activation to their mother's voice (Imafuku et al., 2014) and emotional tone vs. neutral tone (Cheng et al., 2012). Though it is understood that the ability to discriminate between individuals and emotional expressions is necessary to predict others' actions and guide behavior within a social interaction (Frith, 2009), little is known about the predictive value of neural response to these cues on socioemotional outcomes. The current study (N = 21; 8 M, 13 F) examined the predictive value of functional near infrared spectroscopy (fNIRS)-measured prefrontal cortical (PFC) neural response to mother's and stranger's voices at happy and angry tones in early infancy (M_{age} = .98 months) on parent-reported infant socioemotional behavior (BITSEA; Briggs-Gowan et al., 2004) at one year (M_{age} = 13.14 months). Following data collection, a repeated measures GLM identified 4 PFC fNIRS channels as being significantly active in response to the voice task. Bivariate correlations were run across all stimulus conditions on the 4 PFC fNIRS channels with all BITSEA scores. Neural activation in response to mother's happy voice or stranger's angry voice in 3 of the 4 PFC fNIRS channels was significantly associated with BITSEA socioemotional outcome scores including autism spectrum disorder risk scores. These results suggest that neural mother-stranger and emotional voice discrimination in the first months of life may be predictive of parent-rated socioemotional outcomes. More specifically, this neural sensitivity in early infancy may serve as a brain-based biomarker of risk for later socioemotional problems or disorders within the first year of life.

The Studio of the Latino Lover

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A review of art history often gives the impression that only white men have been creating good, impactful paintings and artwork in the last 200 years. This has the effect of excluding diverse voices, experiences and narratives in the arts and beyond into the collective history. The goal of my project is to extend a tumultuous, nuanced aspect of the Latino/Latinx experience in the practice of painting and artmaking. My approach to this will be a juxtaposition of making work that is in conversation with renown artworks, nested into silhouettes that represent racist tropes and stereotypes. This representation helps to illustrate that a diverse population does contribute and is in dialog with realms of art that have historically excluded the marginalized, disadvantaged and people of color. The implication of this project is an essential conversation directly connected to the need for diversity.

Geometry of Object Storage and Recognition in Human Memory

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Objects in the environment have a large variety of appearances due to 3D to 2D mapping, occlusion, self-occlusion and the relative position and orientation between the object and the observer. How does the brain store and recognize objects? There are three main ways we investigated: Structural Descriptions, Perspective Views, and Canonical Orientation. Using the mental rotation paradigm, to investigate how objects are stored and recognized in human memory. The mental rotation paradigm consists of a linear relationship between rotation angle of an object and a subject's reaction time to analyze the object. We investigate if there exists canonical storage in the human brain and if so, what is its relation to figural symmetry and elongation axis. We tested if the reaction time profile can be expressed as a linear combination of these two variables. In these preliminary data, the model appears to capture data relatively well with the possible exception of the 90-degree orientation angles. Preliminary data supports the canonical orientation hypothesis with symmetry playing an important role in determining the canonical orientation.

Social and Affective Impacts of the COVID-19 Pandemic on University Students

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The COVID-19 pandemic has resulted in an unprecedented set of disruptions to university students' learning modalities, mental health, and social interactions. Students have had to pivot to online learning and navigate unexpected social isolation, leading to the development of different ways to connect with social groups as well as different personal pursuits. Despite downward trends in restrictions and growing progress with vaccinations, the pandemic still threatens and has impacts on students' lives daily, such as required testing, mask wearing, and isolation for individuals testing positive for COVID-19. We conducted a study to examine self-reported coping strategies, social interaction, social emotion regulation, and mental health symptoms in university students. We collected data at two time points so that we could compare these variables between spring of 2020 and summer of 2021. Additionally, this is the first line of research to measures university students' levels of social reappraisal support. We tested whether frequency of communication with core social contacts was significantly related to the social reappraisal support students received from those contacts, and if the support was related to mental health symptoms. We then gathered online survey responses from more than 150 university students across North America. Participants were asked to complete various psychometric measures, along with two custom questionnaires: the Pandemic Coping Questionnaire and the Social Network and Reappraisal Questionnaire. In both the current study and the previous study, we observed that students were experiencing less social interaction overall relative to before the pandemic; nevertheless, higher frequency in communication with core social contacts predicted greater social reappraisal support from those contacts. Additionally, we found that perceived stress was significantly lower in the summer of 2021 than the spring of 2020. Finally, participants who reported higher social reappraisal support from core social contacts also reported significantly less perceived stress. These results reaffirm that social contacts are important influences on reappraisal, which may then impact mental health.

Influence of Hypoxia Acclimation and Evolutionary History on the Muscle Structure of Peromyscus Mice

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At high-altitude (>2500 meters above sea level), small mammals are confronted with the challenge of sustaining aerobic processes, such as shivering thermogenesis, in the face of reduced oxygen availability and low temperatures. To overcome these demands, oxygen and metabolic fuel must be supplied to skeletal muscles. This supply requires a sufficient density of muscle capillaries and a high proportion of aerobic muscle fibers (those that use O_2). I tested the hypothesis that different species of mice of the genus *Peromyscus* – which have independently colonized high altitude – have evolved an increase in muscle capillary density and a higher proportion of aerobic fibers relative to closely related low-altitude species. I executed this study by measuring capillarity and muscle fiber types of gastrocnemius skeletal muscle (hereafter, gastroc) samples collected from a previous experiment, where each species of *Peromyscus* was exposed to stimulated elevations spanning normoxia to hypoxia (1000 m, 3500 m, and 4500 m above sea level) for six weeks. Histological sections of gastroc were taken, stained for capillaries and muscle fibers, and imaged on a light microscope. I have quantified images for oxidative fibers, leaving the analysis of capillary density remaining. Results from this analysis indicate an increase in density of oxidative fibers in the gastroc of species that are native to high elevation, relative to those living at low altitude. This suggests that the supply of oxygen and metabolic energy required to maintain aerobic processes is a ubiquitous adaptation of small mammals at high altitude, contributing to their success in profoundly hypoxic conditions.

Using Neural Networks to Extend Experimental Trajectories in Genetic Circuits

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There are many processes in nature which exhibit noisy time series data and for which data collection is difficult. Examples in biology include protein expression in genetic circuits, cell shape, and molecular simulation dynamics. In all these examples, there are practical limitations to data collection including cost and technological or computational difficulties.We present a procedure to extend time series data with machine learning. A gated recurrent unit (GRU) neural network is trained on a simple gene network as a proof of concept. The GRU network then extends a protein trajectory from the gene network. The principle of maximum caliber (MaxCal) is used to assess whether the GRU network has accurately and faithfully extended this protein expression trajectory.Our results indicate that the machine learning model can accurately extend a time trajectory of protein number. This procedure for data extension, combined with the quality control provided by MaxCal, can be extrapolated to more challenging gene circuits and other biological problems where extension of stochastic time series data would be useful.

The Case of Kenya: Evaluating Kenya Slum Upgrading Program from a Sustainable Urbanization Framework

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Global urbanization is occurring at an unprecedented rate. The brunt of this urban growth is occurring in the developing world, where cities pose a substantial threat to sustainability. Sustainable urbanization has emerged as an approach to this challenge which balances environmental, social, and economic concerns throughout the urbanization process. Slums pose a threat to sustainable urbanization in the developing world as they result in stalled economic growth, environmental degradation, and increased social inequality. Given the increasing popularity of slum-upgrading interventions, it is critical that such programs be aligned with the core tenets of sustainable urbanization. Unfortunately, there is a lack of existing holistic and replicable tools to evaluate slum-upgrading programs for sustainable urbanization. The ASPIRE Toolkit is a holistic assessment tool designed to evaluate the sustainability of infrastructure projects in developing contexts. The present study employs the ASPIRE Toolkit to evaluate the Kenya Slum Upgrading Program (KENSUP) for urban sustainability. The ASPIRE evaluation conducted in this thesis revealed that KENSUP performs strongly with regards to essential services, social infrastructure, and environmental management; however, the program performs below the standard for inadequate community participation, inequitable distribution of benefits, insufficient government capacities, and economic disturbances. Overall, the ASPIRE toolkit was found to be an effective tool for the assessment of slum upgrading programs and it is recommended that the tool be employed in future research.

State-Sponsored Cultural Production's Influence On Nationalist Politics In France

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Due to how their unique markets are impacted by governmental action, the French have claims to cultural products in a way that creates tangible manifestations of national identity. Using the central product regulated by the *Appellation d'Origine Contrôlée* (*AOC*), wine, I will see how a particular cultural market can contribute to the rise of nationalistic voting in France. Initially, I will understand the issue through reconciling the academic literature around cultural economics, politics, and nationalism with the rich history of wine and culture in France. From this, I will begin my research by tracking the history and recent successes of the *Rassamblement National* (*RN*), France's most codified right-wing political party. Then, to operationalize this question, I will use local elections in comparative wine regions to see how much cultural markets are both explicitly referenced and implicitly played upon in campaign rhetoric. This will be done by evaluating newspaper articles from local elections since the formation of the *RN*. If the *RN*'s increased claims to French culture translate to the voters through the media, the rise in *RN* success could be tied to the cultural nationalizing of the products that French regions pride themselves on. While the literature may expect a direct casual effect between state-led national identity through tangible cultural products and election results, the research does not show a direct effect of cultural claims as the reason for *RN* success. Yet, France still provides a particularly interesting case study of direct governmental influence in their recognized cultural economies that can still inform the discourse around cultural nationalism in the twentieth century.

Characterization and Comparison of Calcium Oscillations Between Oligodendrocytes and Other Mammalian Cells

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Mucolipidosis Type IV (MLIV) is an autosomal recessive lysosomal storage disorder of the nervous system characterized by severe motor impairment, delayed cognitive development, ophthalmological abnormalities, and a lack of myelin in the brain. It results from mutations that render the ion channel TRPML1 non-functional. TRPML1 is permeable to calcium, zinc, iron, and several other ions. Calcium is a vital ion in the propagation of electrical signals in the nervous system. Oligodendrocytes are the cell type in the central nervous system that produce myelin. As MLIV is a hypomyelinating disorder, studying calcium ion dynamics in oligodendrocytes may give significant insights into the molecular mechanisms underlying this pathological condition. We compared various calcium sensors (FuraRed, Fluo-4, GCamp5, RGECO-1, REXGECO1, and RCamp1h) in Hela cells on their sensitivity. Among these sensors, GCamp5 shows the greatest response to treatment with the drug thapsigargin, which increases cytosolic calcium by blocking the sarco/endoplasmic reticulum Ca^{2+} ATPase (SERCA), leading to release of calcium to the cytosol from the endoplasmic reticulum (ER). We then transfected various cell types with GCamp5 to compare the calcium dynamics of oligodendrocytes to more well studied cell types such as neurons. We also visualized the decrease of ER calcium concentrations in various cell types using the sensor ER-GCamp6-150. Finally, we discovered spontaneous calcium oscillations in mature rat oligodendrocytes that were exaggerated upon depolarization of the cell using 100 µM glutamate and 10 µM glycine. Given the important signaling roles of calcium, the calcium oscillations in oligodendrocytes might contribute to their vital function.

One or the Other: An Exploration of Gender Essentialism and Binary Categorization

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Gender essentialism refers to the belief that binary categorizations of gender, “man” and “woman,” are biologically driven and innate groupings. Essentialist beliefs can contribute to stereotyping and discrimination; however, research indicates these beliefs can be malleable and influenced by language. My study aims to clarify how linguistic gender categories support essentialist beliefs, which may, in turn, support inequality and discrimination. We hypothesize that participants in the binary judgment condition will report greater gender essentialism and stronger views of gender as a binary construct than those in the continuous judgment condition, with participants in the control condition falling in-between.

A Midsummer's Wet Dream: An Exploratory Artists' Book

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A Midsummer's Wet Dream is a work that explores the explicit synergy between performative text and theatrical performance. *A Midsummer Night's Dream* disrupts the cannon of tragedies that populate the Shakespearian Artists' book collections. The work questions how the content and form of Artists' books act together as co-creative presences to redefine the medium of book and of theatrical text. This research project focused on Artists' books that "perform": how does the explicit presence of a "performance" in an already performative medium animate the work? What shape does that multiplicity take? Is the book's physical form an equally explicit conductor of meaning? Over the course of ten weeks, the project unfolded as a series of drafts and "sketch" books that were literary tinder for the final piece. Through mentorship with bookmaker Alicia Bailey, further iteration was made to the project, and key insight was gained in the practices of bookmaking. *A Midsummer Night's Dream* became the conduit for this work due to the "play within a play" that ultimately informed the form of the book. The final work took shape as a single edition book, comprised of a "book" shell of *A Midsummer Night's Dream* that houses a pop-up book that details the play within *A Midsummer Night's Dream*. This work has since been collected by the DU special collections library and joins in a lineage of artist books that engage deeply with theatrical texts.

Amplifying Youth Through Art

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With the rise of social activism, young people are searching for ways to engage community members and policy-makers in what they care about. Amplifying Youth Through Art (AYTA) aims to empower youth to use artistic outlets (photography and theatre) to highlight the issues they find most timely and important. Through intentional integrated social-emotional learning activities and a curriculum that promotes aesthetic learning, students strengthen their sense of self and vulnerability while deepening their perception of the issues they choose to explore. The result of this project-based research is a final community sharing determined by the youth.These final sharings are set for May and the implications of the project will be explored after that.

The Renaissance of American Big Band Jazz: An Exploration in Contemporary Presentation

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The Renaissance of American Big Band Jazz: An Exploration in Contemporary Presentation is a project aimed towards answering the question: What contemporary demands establish the guidelines of modern music consumption, and how can students apply these guidelines to the knowledge and skills acquired through the pursuit of degrees at the Lamont School of Music to proliferate the success of their professional careers? I believe that the demands of contemporary music consumption require a multimedia approach, marrying a variety of artistic forms to grab the attention of modern music consumers, who now expect to engage with art through myriad simultaneous sensory experiences. In this project, I will innovate a revitalization of big band jazz consumption. I will combine big band jazz arrangement and instrumentation with original musical composition, modern electric pop band instrumentation, live musical performance & improvisation, live visual art, and cutting-edge videography to create a singular yet multidimensional piece of art. This piece will be distributed across a variety of digital platforms, as will an alternate version consisting only of audio material. I will analyze the online world's differing engagement with each respective form (video vs. audio) with the goal of proving that a multimedia approach yields a more popular product. With this project, I intend to electrify the golden era of American big band jazz. By bringing classic big band instrumentation and musical style into a realm of presentation that is palatable to the ears and eyes of the modern consumer, I will create a more engaging experience for the audience, reintroducing intellectually and instrumentally intricate music to the popular eye.

Optical Vortex Nucleation Behind A Circular Obstruction

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From whirlpools in water to tornadoes in air, vortices are a common natural phenomenon. Vortices also occur in light, opening up the possibility of using light to study fields such as quantum computing and quantum fluids. Previously, light beams with vortices have also been used to study the spot of Arago. The spot of Arago is a landmark experiment verifying the wave nature of light by showing that a bright spot appears in the center of a beam after the beam encounters a circular obstacle. In this thesis, rather than using optical vortices to investigate the Arago spot, I instead explore using a circular Arago-like obstruction to generate optical vortices. I compare computational and experimental data where I displace a circular obstruction in the path of a Gaussian light beam, and I characterize the formation of an optical vortex pair in the far-field past the obstruction. In both sets of data, the results show that the formation of the vortex pair is dependent upon the distance of displacement of the obstruction. These results have the potential to be used to study quantum turbulence and the formation of vortices in quantum fluids containing obstacles.

Mutations in the Human VPS41 Protein and Their Effect on Insulin Secretion

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The protein VPS41 is an established subunit of the homotypic fusion and protein sorting (HOPS) complex, which acts as a tethering complex and facilitates endolysosomal fusion. However, VPS41 may function independently of this complex in the formation of insulin granules contributing to secretion of insulin, a process that is still poorly understood. The absence of VPS41 disrupts insulin regulated secretion, alters secretory granule morphology, and leads to a reduction in the number of secretory granules in pancreatic beta cells. Here we investigate how point mutations in the human VPS41 gene impact insulin secretion, HOPS complex function, and exocytosis in INS-1 cells. Notably, we found that 3 mutations (T52R, R416C, and E432K) led to a decrease in stimulated insulin secretion, and 2 of those (T52R and R416) had no impact on HOPS function, indicating that the role of VPS41 in insulin secretion is independent of the HOPS complex. Additionally, we verified that loss of VPS41 disrupts regulated exocytosis using TIRF imaging. KO INS-1 cells, on average, had significantly fewer exocytotic events over a 1-minute period than the hWT cells did in response to glucose stimulation. Overall, these results not only add support for previous findings, but they also identify regions of interest within the VPS41 gene that should be investigated further. T52R, R416C, and E432K all reside within the GTPase-binding domain of the protein, suggesting that VPS41's role in insulin secretion may be mediated through interactions with a small GTPase. Further research should explore this possibility.

CO Releasing Organic Polymers for Biomedical Applications

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Carbon monoxide (CO) is produced in small quantities by the human body, and has proven to be an important signaling molecule (Mahan, 2012), vasodilator (Kozma et al., 1999; Johnson et al., 1995), anti-inflammatory (Motterlini et al., 2012; Otterbein et al., 2000) and tumor-suppressant. Here, we will develop a new class of polymeric carbon monoxide releasing molecules (CORMs) that efficiently release CO gas via photolysis. These CORMs will be engineered to produce non-toxic byproducts after the release of CO and are readily metabolized in the human body.

Examining Motivational Influences on Cognitive Control and Memory

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This project seeks to expand on a recent finding that cognitive control influences memory encoding (memory is better for stimuli encountered on conflict versus non-conflict trials in a cognitive control task; Krebs et al., 2015) by investigating the effect of approach versus avoidance motivation on this relationship. Motivation may have varying influences on cognitive processes depending on the type of motivational valence (i.e., reward approach versus punishment avoidance). Reward versus punishment motivation effects on cognitive performance have been associated with activity in different brain regions, but these effects typically are studied on control or memory in isolation. The effect of motivation on the relationship between cognitive control and memory encoding is currently unclear. To approach this problem, this study employs functional magnetic resonance imaging (fMRI) during performance of a behavioral task which requires participants to resolve cognitive conflict under differing motivational contexts and a follow up memory test for task stimuli. The modulation of performance on conflict tasks and subsequent memory tasks is examined in terms of activity in the brain regions of interest. fMRI findings from this study will be used in a follow-up study to target brain regions with transcranial magnetic stimulation (TMS), prior to task performance, to confirm their role in the observed differences. Preliminary analysis of the behavioral data from our first fifty participants shows that induced approach motivation decreases response time without damaging the accuracy of responses, while also improving next-day memory of stimuli. These results fit predictions based on the hypothesized mechanism of increased activation of the hippocampus via dopaminergic projections from the prefrontal cortex in potentially rewarding situations.

A Cross-Coupling Approach to Synthesis Of BEPs: Faster Access to Probe Conditions

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The Michel Group has recently reported fluorescent small molecule probes for the detection of ethylene, a hormone released during key life cycle events in plants and commonly associated with fruit ripening. To improve the sensitivity and selectivity of these probes, it is necessary to synthesize analogues and evaluate how structural changes will influence photophysical properties such as limit of detection and fluorescence turn-on. However, the previous approach to this synthesis relied on a laborious multi-step process that requires significant time and resource commitments for each new probe. To overcome this synthetic challenge, we developed a convergent synthetic approach that reacts two advanced intermediates using a Palladium (Pd)-catalyzed cross coupling. Initially, a series of coupling partners, catalysts, and reaction conditions were evaluated tooptimize the cross-coupling reaction. Once conditions were favorable, a series of different substituents on the aromatic rings of the probe were tested for their influence on photophysical properties. Results indicate that structural modifications can improve the brightness of the BODIPY fluorophore, but more data is needed on how they can be used to strengthen other properties such as lowering background fluorescence turn-onand limit of detection.Overall, a convergent synthetic approach increases the accessibility of BODIPY Ethylene Probe (BEP)analogues, allowing for more rapid evaluation of these structural modifications. Additionally, the reported cross-coupling conditions are valuable to other researchers working in fluorescent probe synthesis.

Homophobia, Politics, and Public Health Protection: HIV Criminalization Law in California from 1985-1998

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Despite there being an extensive amount of scholarship on the history of the HIV/AIDS epidemic, little has been written about the history of the criminalization of HIV status. This thesis seeks to help fill that gap in the field through a study of the history of HIV criminalization in California. This project uses archival documents and newspapers to help explain how and why criminalizing legislation was put in place. Conservative legislators in California proposed criminalizing legislation under the guise of protecting public health in order to gain support.While politicians and legislators presented legislation as essential to public health protection,evidence proves that they were motivated by fears surrounding the epidemic, most specifically homophobia. Homophobia was a clear motivating factor in HIV criminalization as conservative legislators sought to have some sort of social control over high-risk groups, HIV positive individuals, and gay men in particular. Many public health officials actively objected conservative arguments, but this did not prevent legislators from achieving some level of success in their efforts to enact criminalizing legislation. This success was partly enabled by the political climate leading up to the 1988 election, as AIDS was used as a key issue in political discourse. This thesis provides ample evidence to demonstrate the different motivations and enabling factors in enacting HIV criminalization.

The Effects of Reason for Wrongful Conviction on Perceiver Stereotype Endorsement and Hiring Judgments

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The proposed work examines the effect of wrongful conviction and the reason for wrongful conviction (i.e., false confession vs. eyewitness misidentification) on employment-based discrimination. Participants will read a job application from either a) an exoneree whose conviction is attributed to false confession, b) eyewitness misidentification, or c) an individual with no criminal history before completing measures of stereotype endorsement and employment qualification. I hypothesize that stereotype endorsement and job fit impression will serially mediate the relationship between applicant condition and starting wage offered as well as hiring decision, with the false confession exoneree being evaluated more negatively than the misidentified exoneree and both exonerees being evaluated more negatively than individuals with no criminal record. The results after completing this study found that our hypothesis was partially supported. The false confession exoneree was evaluated most negatively on all dependent variables compared to the misidentified exoneree and the individual with no criminal history, which did not differ significantly. Further, we found a significant serial mediation where stereotype endorsement and job fit impression mediated the relationship between applicant type, starting wage offered, and hiring decision. A disturbing implication of our results is that there may be a reluctance to hire exonerees who falsely confessed because there may be negative stereotypes of this group and thus perceived as less hirable.

Stressful Life Event Effect on Sleep and Emotion Regulation

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High levels of stress can negatively impact both physical and mental health. Emotion regulation is critical for coping adaptively with stress. Research studies have shown that stressful events may disrupt sleep, which in turn may decrease positive affect and increase negative affect, which may be products of emotion regulation success. The relationship between perceived stress and emotion regulation has not been examined when looking at sleep as a mediator. Using a dataset examining self-reported physical health and positive and negative affect in the aftermath of a stressful life event, we will examine relationships between perceived stress, positive and negative affect (measured using the PANAS questionnaire), and sleep. We hypothesize that participants who have experienced a recent stressful life event will have lower emotion regulation success. Moreover, we predict that poor sleep will mediate the relationship between perceived stress and affective outcomes. This study will contribute to knowledge about the effects of physical health on stress and cognitive functioning, and further understanding of the importance of healthy sleep as a way of coping with stress.

Primary Caregiver, Sibling Acceptance of LGBTQIA+ Family Members

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Religion has been shown to help mitigate negative mental health outcomes by promoting positive coping styles and spiritual support (Brewster et al., 2016); however, it is important to understand potential negative impacts religion may have on the LGBTQIA+ community considering many religious beliefs labeling sexual or gender minorities as sinful (Macbeth et al., 2021). There is extensive research outlining the mental health disparities that the LGBTQIA+ community faces and explanations for the disparities. One such example is that it is estimated that 40% of the LGBTQIA+ community has been rejected by a family member or close family friend (Pew Research Center, 2021). The current study aimed to investigate how primary caregiver and sibling acceptance may predict internalized stigma and non-suicidal self-injury (NSSI) frequency within LGBTQIA+ individuals who grew up in religious households. The motivation behind this project was to contribute to improving the mental health outcomes of LGBTQIA+ individuals who grew up in highly religious households by investigating how familial support may decrease internalized stigma and NSSI. I approached this project by measuring acceptance of primary caregivers and siblings with the Family Acceptance Scale (Miller et al., 2020) and openness of the LGBTQIA+ individual with their family using the Openness Inventory (Mohr & Fassinger, 2000). Additionally, I measured the participants' internalized stigma levels with the Lesbian, Gay, Bisexual Internalized Stigma scale (Mohr & Kendra, 2011) and their NSSI frequency levels with the Self Injurious Thoughts and Behaviors revised scale (Fox et al., 2020). Results demonstrated that primary caregiver support predicted NSSI but not internalized stigma whereas sibling support predicted internalized stigma but not NSSI. This study demonstrates that family acceptance does carry weight. Moreover, having primary caregivers and sibling acceptance predicting different things may denote that there may be different mechanisms at play.

Site-Directed Mutagenesis to Characterize Manganese Binding Site of SARS-CoV-2 NSP15 Protein

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To carry out successful infection, coronaviruses must avoid detection from their host's immune system. All vertebrates infecting *Coronaviridae*, like SARS, MERS, and the novel SARS-CoV-2 (COVID-19), contain homologous versions of Nsp15, a specialized endoribonuclease enzyme that preferentially targets uridine nucleotides (EndoU) which assists coronaviruses in avoidance of the immune system throughout the viral lifecycle. Nsp15's function and activity are dependent on the divalent metal manganese, thus we investigated the potential location and biochemistry of the metal-binding site (which is currently unknown). In fact, in the absence of NSP15 coronaviruses are not viable and if the metal manganese is not present, NSP15 consistently lacks activity (Bhardwaj et al., 2004; Ancar et al., 2020; Deng et al., 2017; Kindler et al., 2017). Four amino acid residues were mutated on NSP15, three of which represent putative metal-binding sites, and the fourth catalytically dead mutant were generated using a specific Polymerase Chain Reaction technique, Site-Directed Mutagenesis. Mutated plasmids were propagated in *Escherichia coli*, cultured, and induced to produce wild-type and mutant NSP15s. Each protein was purified by Fast-Paced Liquid Chromatography (FPLC) incorporating Nickel Immobilized Metal Affinity (Ni IMAC), glutathione-S-Transferase (GST), and size exclusion chromatography techniques. Future research will focus on biochemically characterizing and determining the precise location of the manganese binding site within NSP15, which may be necessary for developing novel treatments for inhibiting SARS-CoV-2 replication among other related viruses containing NSP15.

Structure/Function Studies on the MRAP1 of Amia calva

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Previous studies of the N-terminal domain of mammalian MRAP1 indicated that the amino acid motifs LDYI (i.e., the activation motif), and YEYY (i.e., the secondary activation motif) are essential for facilitating the activation of mammalian MC2R, a critical component of the mammalian hypothalamus/pituitary/adrenal axis. This study tested the hypothesis that the corresponding motifs (i.e., $Y^{18}D^{19}Y^{20}I^{21}$, Y^{14} $E^{15}Y^{16}$ F^{17}) in the N-terminal of the MRAP1 ortholog of the neopterygian fish, *Amia calva* (i.e., the bowfin) are essential for facilitating the activation of bowfin MC2R, a critical component of the bowfin hypothalamus/pituitary/interrenal axis. To test this hypothesis a series of alanine-substituted mutants of bfMRAP1 were made. Alanine substitution at every position in the $Y^{18}D^{19}Y^{20}I^{21}$ motif completely blocked activation of bfMC2R. Single alanine substitution in this motif indicated a gradient in the inhibition of activation: $Y^{18} > D^{19} > I^{21} > Y^{20}$ (percent inhibition 80% > 52% > 25% > 10%). These results confirm that the $Y^{18}D^{19}Y^{20}I^{21}$ motif is the activation motif for bfMRAP1. Surprisingly, single alanine substitution at the $Y^{14}E^{15}Y^{16}$ F^{17} motif also completely blocked activation. Perhaps this motif is required for the structural integrity of the N-terminal of bfMRAP1. In any event, this study supports the hypothesis that bony vertebrate MRAP1 orthologs must have a δDYδ motif in the N-terminal domain to facilitate the activation of bony vertebrate MC2R orthologs. Hence, the MC2R/MRAP1 heterodimer is a critical component of the hypothalamus/pituitary/adrenal – interrenal axis.

Ground-Air Robot Cooperative Tracking of an Adversarial Agent

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From nursing homes to war zones, losing track of someone's location can mean bad news. Keeping a close eye on someone's whereabouts is invaluable, and sometimes it is necessary. The use of security cameras or even ground robots would be ideal, however lack of control of the environment in which you want to locate people would prohibit cameras. Further, in situations where the environment is unknown or unpredictable, previous knowledge of the layout would not be available, which would be extremely challenging for a single ground robot to simultaneously navigate and track an agent. To address these challenging constraints, I created a multi-robot system composed of a ground robot capable of image-based object recognition and an agile aerial robot with rudimentary navigation and sensing capabilities. The system utilizes the object recognition capabilities of the ground robot to locate and begin tracking an agent, in our case a human, and spatially tasks the aerial robot to get within close proximity of the human to then begin tracking. When implementing this solution, I addressed multiple challenges regarding identifying and tracking a human from both ground robots' perspective and the aerial robots' perspective. I have currently addressed the challenges of the ground robot identifying and tracking a human and spatially tasking the aerial robot towards the human. Future challenges to tackle involve the aerial robot tracking the human using only rudimentary navigation and sensing capabilities. Implications include utilizing both the ground robot sensors and the aerial robot sensors to get a more accurate estimate of the true position of a human and scenarios where the human has moved to a location where it is not feasible for the ground robot to navigate to it, but the aerial robots maintain tracking of the human.

Machine Learning and Cybersecurity Applications

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Intrusion detection systems (IDS) are a specific branch of cyber-security that scans for malicious activity within a network. With the help of machine learning, a more efficient detection process can be created. Through the different combinations of neural nets, the accuracy of an IDS could potentially be optimized. The CICIDS2017 dataset was utilized to study certain cyber-attacks (DDoS, Brute Force FTP, Brute Force SSH, DoS, Heartbleed, Web Attack, Infiltration, and Botnet) by simulating certain web traffic over the course of five days. Various combinations of dense layers were used to view the changes in accuracy within this IDS. The losses and accuracy of each trial were displayed on multiple line graphs. To acquire the most efficient results, it was of the utmost importance to not design the neural network with an abundance of hidden layers.The IDS required a balance within the complexity of the network to produce superior results.This coincides with the Bias-Variance Dilemma: a tradeoff between how much predicted values differ from true values and how predictions made on the same value vary on different realizations of the model.

Saving the Sparkle: Conserving Schlumberger Jewelry and Drawings, circa. 1950-70

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The Virginia Museum of Fine Arts (VMFA) owns the largest collection of jewels, drawings, and decorative objects by French designer Jean Schlumberger in the world. His colorful, whimsical, and nature-inspired pieces remain in dazzling condition due to consistent preservation efforts by the museum's conservation staff. As a VMFA paper conservation intern in the summer of 2021, I researched the life and work of Schlumberger and performed treatments on his tracing paper drawings. Working side-by-side with conservators on this project, I learned the value of surface cleaning, washing, and properly housing art objects. These conservation treatments, among others, removed the harmful dirt, adhesives, and acids that contributed to the degradation of the drawings. Post-treatment, conservators housed the drawings and art objects in archival standard frames, boxes, or cases so that the objects maintain physical and chemical stability and patrons and researchers can enjoy them for years to come.

The Effect of Temperature on the Phenology of Fall Webworm

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As global temperatures rise, climate change is expected to have significant effects on Earth's ecosystems and insect populations. Specifically, heatwaves are starting to increase in intensity and frequency, which negatively impacts insects as insects are particularly sensitive to temperature variation. Increasing temperatures and heatwaves can affect plant-insect synchrony as well as the timing of important life-history events. The generalist insect herbivore fall webworm (*Hyphantria cunea*) is a moth species local to Colorado, and it can occur in diverse environments and feed upon a variety of host plants. It is known that fall webworm larvae can have considerable variance in their performance when reared on different host plants. It is unknown the extent to which the type of host plant affects the development of fall webworm larvae under different thermal conditions. This project investigated how fall webworm performance is affected by thermal stress (climate change) through elevated temperatures and heatwave conditions. Performance was measured by survival, development time, and pupal mass. Further, this project examined whether larval development and mortality vary depending on the type of host plant. The results suggest that increased temperatures had an overall negative effect, but that diet could mitigate these effects. Additionally, there was a significant interaction between host plant type and heatwave duration, which means that larval performance during a heatwave was dependent on host plant. This project supports the evidence that higher temperatures and heatwaves have negative effects on insect populations, but the extent may vary depending on quality of diet.

Tipping in Hotel Housekeeping

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Researchers have investigated variables associated with tipping in restaurants for decades, but few have investigated the tipping of guest room attendants (GRAs) – also known as housekeepers – in hotels. Unlike in hotel housekeeping, tipping norms in the restaurant industry are well established, and restaurant servers are visible to the guests they serve and who tip them. Typically, GRAs have no direct contact with the guests and thus are "invisible." Given the invisibility of GRAs, they must find a unique way to "touch" guests to evoke immediacy and intimacy. In addition, since a majority of GRAs belong to a minority group, especially Latinx, it is important to investigate how race/ethnicity impacts customer tipping. My experimental design captured 316 respondents through "Centiment" and tested the relationship between multiple variables associated with tipping intentions and tipping amounts for GRAs in the context of (in)visibility as well as race/ethnicity. Generally, the results showed that there was no statistically significant difference between the tipping amounts for the white or Latina housekeeper. However, the participant's perception of room cleanliness, feeling of empathy, and the social presence of the tent card were all associated with higher tipping amounts. When the participant felt manipulated after viewing the tent card, they tipped less, which had the highest correlation from the results. Fundamentally, my research tested the theory of social presence which has never used to bring visibility to invisible employees. Future research will hopefully expand on this theory in a similar light and add to existing findings.

Between Populism and Settler Colonialism: A US Case Study

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United States political history is a uniquely populist and settler one. While there is plenty of scholarship on populism and on settler colonialism separately, there is a significant gap in understanding how the political phenomena are connected. To begin to remedy this gap, I argue that particularly in the US political context, populist and settler colonial sociopolitical logics are both historically and theoretically interconnected. Both political phenomena are central to understanding the foundations of American socio-political life. Working in a theoretical-historical mode, I identify five ways in which settler colonialism and populism have intersected, and in the process produced a set of functions: to categorize, stigmatize, dismiss, authorize, and defy. These function reveal a mirrored internal logic to populism and settler colonialism. Using this theoretical analytic, I will then discuss four major moments of populist politics in the US: Shay's Rebellion, Andrew Jackson's presidency, the emergence of the People's Party, and Donald Trump's presidency. Ultimately, this thesis will reveal that both populist and settler colonial political logics are interdependent, foundational, and continuous features of US politics and that, therefore, populism and settler colonialism in the US context ought to be considered in tandem.

Bridging the Gap: Connecting Resources to Underserved Schools

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When I first entered as a Puksta Scholar my freshman year, I was interested in tackling the subject of mental health amongst immigrant communities. However, after spending a year working for the Denver Workforce Center as an intern, I became aware of a different need within my community. Growing up I attended a K-8 school which served many people from lower to middle income groups. However, I attended high school in a much more affluent area. This made me aware of the differences, not only in the quality of education, but in the way in which students are connected to potential opportunities and resources to better their future. I only became aware of some of the opportunities and resources available to middle and high school students after my time with the city. Job fairs, mentorship, and internship opportunities as well as summer tech camps with full scholarships and free laptops. These are tools that would have been extremely helpful to me while I was attending my previous K-8 school. Students should not feel like they cannot succeed because of their economic background. And by simply exposing students from these underserved schools to the very resources intended to support them, they may find that they are capable of more than they thought. These tools are intended to equip the youth with the tools they need to meet their future career goals and find a job they truly like and are passionate about. I am in the process of establishing a connection with my former supervisor and colleagues with the city and plan on reaching out to my old school as well (as a starting point). My goal is to host talks that share what kinds of resources are available, particularly for students about to enter high school as this could give them a strong advantage when applying for college and jobs in the future. I experienced several delays and disruptions due to the COVID pandemic but hope to move forward as circumstances continue to improve.

Modelling the Effect of Tethering on Exosome Secretion

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Exosomes are small membrane vesicles that are found inside larger vesicles called multivesicular bodies (MVBs). Exosomes contain cargo molecules which they transport between cells. This is used by many natural processes in the human body as well as some diseases. Understanding exosomal transport can help explain the mechanisms of these processes and lead to new targets for intervention in diseases. An important part of this process is the secretion of exosomes from the cells. When exosomes leave cells, MVBs fuse with the cellular membrane, exosomes are subsequently released. Recent research uncovered an interesting property of this process: the exosomes take a significantly longer time to leave the site of the MVB fusion than they would if they were allowed to move freely after the fusion. It appears that there is something that constrains their movement and holds the exosomes in place for some time. Recent work determined that one possible cause of this is due to a protein called tetherin that holds exosomes to the cell surface. In our work, we approached this slow release from the fusion site by developing a computer simulation of how exosomes move away post fusion. The simulation modelled this as diffusion, which leads to an exponential decay of number of exosomes left at the fusion site in time. Experimentally determined parameters were used to simulate the decays. The simulation was able to accurately replicate the experimental decays and determine properties of these exosomal tethers such as their lifetime, fractions of tethered exosomes and how do these properties vary with temperature. The properties suggested by the simulation can be used to more accurately describe how exosomes leave cells, which will provide insight into the mechanisms used by different diseases to propagate and a better understanding of the human body in general.

One Star, Two Star, Red Star, Blue Star: Probing the Binary Status of the Wolf-Rayet Stars WR 12 and WR 71 with Spectropolarimetry

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Massive stars lose their mass through high stellar winds which create dense circumstellar structures of dust and gas around the star. The mass and angular momentum lost from the star shapes its future evolution. In the case of massive Wolf-Rayet (WR) stars, they may show periodic variability due to rotation or interaction with an O-star or compact companion. By studying how light is scattered in their stellar winds, through time-dependent polarimetry, we can begin to constrain the geometry and mass loss process of these systems. Our team obtained spectropolarimetric data from several southern hemisphere WR systems using the Robert Stobie Spectrograph (RSS) on the Southern African Large Telescope (SALT). I analysed data pertaining to two of these systems, WR 12 and WR 71, whose binary status is not confirmed. I investigated the radial velocities of each WR star, as well as the time dependence of both continuum and line polarisation behaviour, including estimating interstellar polarisation (ISP) contributions, which have not been estimated before. The radial velocity calculations shed light on the current ephemerides for these two objects, suggesting that the ephemeris for WR 71 needs to be redefined. The continuum polarisation behaviour does not follow the expected variations based on the generally-accepted BME model for either system. The integrated line polarisation values show evidence for an elongated outer wind structure in WR 12 but not in WR 71, suggesting that the WR star in WR 12 may be a rapidly rotating potential gamma-ray burst progenitor. To better characterise the polarised emission line profiles, I developed a technique to assess the asymmetry of each profile. These results indicate large differences between emission lines of different ionic species, as well as between emission lines of same species between the two different targets. I discuss the implications of these findings in the context of the geometry and binary status of WR 12 and WR 71.

Contextual Influences on Trust: Automatic Deception Detection

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Despite the social importance of trust, studies show that humans are poor at explicitly distinguishing between when a person is lying versus telling the truth. However, people exhibit different physiological responses to lies versus truths. We propose that people unknowingly monitor their environments for deception, and such monitoring informs the degree to which those people expect others to be deceptive. Therefore, being in an environment of lies (vs. truths) would cause people to have less trust in others. We manipulated the environment by randomly assigning participants to watch videos of people (2, 4, 8, or 12) lying or telling the truth. Participants then read a paragraph about an individual (Bob) and rated how trustworthy he seemed. Participants rated Bob as less trustworthy after being exposed to lies (vs. truths), suggesting that being in a deceptive environment might make people distrustful even if they do not realize they are surrounded by liars.

A Novel Online Robot Design Research Platform to Determine Robot Mind Perception

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A common issue encountered by practitioners of Artificial Intelligence (AI) and Machine Learning (ML) is a lack of salient data to use in training. A common issue in Human-Robot Interaction is a gap in understanding how robot designs are perceived by the user. The "D U Want to Build A Bot" (Build-A-Bot) project is developing a novel robotic design research platform implemented as a web-accessible 3D game that will allow us to quickly gather many user-provided robot design examples. These examples are then used to train ML models to better evaluate robot designs, predict how a design will be perceived, and create new robot designs. It is anticipated that we use Convolutional Neural Networks (CNNs) to predict how an existing robotic design will be perceived, and Generative Adversarial Networks (GANs) to create new robot designs based on the user provided examples. This paper outlines the current and future work accomplished by an interdisciplinary student team at the University of Denver consisting of 14 undergraduate students across Computer Science, Music, Emergent Digital Practices, Psychology, and other related STEM fields that have created Build-A-Bot.

The Impact of Spermine on Alpha-Synuclein Aggregation and Cell Viability in Parkinson's Disease

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Alpha-synuclein (αS) is a dopamine-regulating protein in the brain that can form aggregates, clusters of misfolded proteins, and cause neurodegeneration in the form of Parkinson's Disease (PD). This research project explored the hypothesis that αS aggregates in the presence of the polyamine spermine – of which there are elevated levels in PD patients – induces toxic forms of αS aggregates and promotes cell death. With a better understanding of the interactions between naturally existing brain chemicals and the protein that causes PD, we will be that much closer to finding more effective treatments, or possibly a cure. I went about researching αS with three assays: an MTT cell viability assay, a ProteoStat aggregation assay, and immunofluorescence staining. We found that spermine can be shown to increase the level of aggregation of αS, as well as decrease cell viability, implying increased toxicity. These findings provide a new point of attack for Parkinson's Disease research. With spermine now available as a clear target, we can work on developing other biomolecules that will inhibit the effects that spermine has on protein aggregation. These findings open the door barring a cure incrementally more, and give us a stepping stone from which to launch new hypotheses and research projects.

Financial Feasibility Analysis on Asteroid Mining

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My thesis is built around identifying key elements that are we are running out of on Earth but are found in high quantity up in space. I chose rare earth elements as they are increasing in usage on a rate of 10% per year with an already established limited supply. I then used research form Professor Elroy from the university of Carlton to identify what the cost of an autonomous self-replicating mining facility. This was then utilized to find what the return on investment would be for mining each of those elements. I then averaged the profits between all the elements and accounting for inflation and subsidies totaled the value to identify after how many years it would take for the investment to start profiting. I then came up with a second analysis based on the four most profitable rare earth elements and what the rate of return would be if they were exclusively mined. As such my analysis concluded that the year Asteroid mining would become profitable would be in 2045 which lined up with when for national security reason it would become necessary to find alternative sources of crucial elements.

Elucidating the Relationship Between Amyloid Aggregation and Inhibition of Polyamine Synthesis and Senescence in Down Syndrome Fibroblasts

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Down syndrome (DS) is a genetic condition characterized by a full or partial copy of chromosome 21 (T21) resulting in premature aging and a variety of neurodevelopmental and physical disabilities. Recent published data by others indicate that senescence-associated phenotypes in DS are linked to a global transcriptional dysregulation. The number of pathways leading to increased senescence in DS is broad and the many components involved are not well defined in their relationship with aging. Polyamines (PA), which are polycationic small molecules involved with cell proliferation, gene regulation, autophagy, and apoptosis, have been reported to be beneficial for aging. While a larger percentage of DS cells in a population becomes senescent faster than normosomic cells, we have found that they also carry a significantly increased presence of PAs. Thus, there is a lack of consensus regarding the role of PA in aging, and in this study, we investigate how PA impacts cellular senescence in DS using flow cytometry to reliably and rapidly measure levels of senescence and death. We prevented endogenous PA production through the addition of α-difluoromethylornithine (DFMO), an inhibitor for the enzyme ornithine decarboxylase, which is the rate-limiting enzyme in the PA synthesis. Next, we added exogenous PA (putrescine, spermidine, spermine) individually to investigate how each PA impacts senescence in human DS and control fibroblasts. Early experimentation showed neither PA nor DFMO alone was sufficient in altering senescence. Interestingly, when we combined DFMO with the exogenous introduction of individual PA (putrescine and spermine), senescence in trisomic cells was significantly reduced. This data describes how the altered production of PAs relates to aging and related diseases. Further dissection of the role of PAs in DS-induced cellular senescence could reveal novel therapeutic targets for altering senescence rates, a common mechanism in many age-related diseases.

Female Age-related Brain Immune Changes And Numbness

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The motivation for this project is to further understand cellular mechanisms that are responsible for Female Age-related immune Changes and Numbness. The information that is available regarding immune changes in correlation to numbness is limited; this information is even more limited for the brains of females. My project investigated how immune cells in the hippocampus region of the brain contributed to neurodegeneration over time in female rodents. The hypothesis was that increased levels of immune cells in the brain contributed to worse cognitive outcomes associated with aging. I focused on two immune cell populations, microglia and t-cells, as both can regulate brain inflammation in the hippocampus. The approach to the project was to obtain brain slices from mice, stain the slices, and quantify the amount and shape of the microglia. Viewing the microscope slide was important to visually analyze microglia and t-cells. The quantification of the microglia is still in process. Given that research would be able to find a correlation between immune changes and numbness, there could be further research about how this relationship could be mitigated to prevent aging females from experiencing increasing feelings of numbness over time.

Revealing the Structure of Wolf-Rayet Binary Systems: WR47 and WR62a

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Wolf-Rayet stars are massive highly luminous stars with incredibly strong winds. These stars often occur in binary systems with main sequence O-type stars. The interaction between the WR and O-type stars creates conic wind collision regions that rotate with the binary system. Using polarimetry to measure the polarization of the light from these stars can provide insight into how these winds interact, their shape and orientation, and what they're made of. Comparison of the polarization behavior of strong emission lines with one another and with the continuum helps determine where the lines arise and scatter within each system. The specific stars I focused on are WR47 and WR62a. I found polarimetric evidence for non-axisymmetric colliding winds in each system and derived some system parameters including their orientations on the sky and the opening angle of the shock cone in WR47. The two systems behave differently from one another and from V444 Cyg, a well studied WR+O binary of similar type.

Exploration of Cobalt Catalysts as Catalytic Chain Transfer Agents in Crosslinked Photopolymers

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This scholarship seeks to evaluate the ability of a specific set of catalysts to alter the mechanical properties of crosslinked polymers formed with light. These catalysts will be derived from inexpensive, easily prepared cobalt species and will allow control over the material's crosslinking density, material properties, and network topography without losing the positive effects of photopolymerization. Traditionally, the free-radical polymerization of methyl-methacrylate (MMA) produces a high molecular weight poly(methyl methacrylate) (PMMA) which is further processed into very hard, transparent plastic goods (e.g. Plexiglass). In the 1970s cobalt(II) complexes were shown to greatly reduce the molecular weight of the free-radical polymerizations of various methacrylate based monomers in catalytic quantities (ppm levels) to produce high viscosity liquids. To date, this catalytic technique, frequently dubbed Catalytic Chain Transfer (CCT), has only been extended to reduce the molecular weight of linear polymeric methacrylates and has not been explored in crosslinked polymers. Here, we will investigate the ability of cobalt(II) complexes to catalytically alter the material properties of crosslinked, methacrylate-based photopolymers. We anticipate that this catalytic technique will find application in dentistry and 3D printing to create plastic goods with material properties not currently accessible with commercial formulations.

How Do Quadruplexes Help Proteins Fold?

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Protein aggregation is the underlying cause of neurodegenerative disorders like Alzheimer's, Huntington's, and Parkinson's disease. Certain proteins have been found to prevent aggregation or promote folding; these are called chaperones. The Horowitz lab has shown through research with G-quadruplexes that these nucleic acids act as chaperones to decrease protein aggregation and appear to promote folding due to their structure. Based on these previous findings we looked deeper at how chaperone impacts folding structure. CD experiments showed that G-quadruplexes were able to help proteins not misfold when heated. This is a critical part in understanding how these diseases occur and can be prevented in the future. During the CD experiments, the proteins that were combined with G-quadruplex only unfolded partially,compared to fully unfolding without the G-quadruplexes. Once they were heated, CD spectra were also taken during the cooling process. From these initial experiments we found that two proteins when combined with a certain G-quadruplex were able to reform a greater degree of structure upon cooling to room temperature. These quadruplexes will be used for further research that looks into measuring their folding through activity assays. We will be focusing on the two proteins that showed the highest amount of recovered structure after heating. For a protein to be functional it needs to be in its native state. The activity assays will be able to determine how much of the protein is active and functional after heating.

Synthesis of Neopentoxy Boron Dipyrromethene Ethylene Probe-4 (Neo BEP-4) and Evaluation of its Optical Characterizations

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Ethylene is an important plant hormone responsible for plant growth and development due to which several current ethylene detection techniques have been developed but are not suitable for its detection at the cellular level. Michel Lab at DU has synthesized two pro-fluorescent BODIPY Ethylene Probes (BEP) i.e., BEP-4 and BEP-5 to quantify ethylene gas through fluorescence. These 1st gen probes, however, have relatively slow turn-on rates which limits their sensitivity. We hypothesized that varying R group attached to the chelating O atom can develop more sensitive ethylene detection probes. BEP-4 analogues such as MBEP-4 and Phenoxy BEP-4 have already been developed, but their higher reactivity with ethylene decreases probe stability. Probes with faster turn-on rates and better stability are preferred since they have an improved limit-of-detection (LOD), and many biological activities in plants respond to a low level of ethylene. Specifically, my research project is focused on synthesizing Neo BEP-4 following the synthetic route comprised of six steps. After its synthesis, this faster probe analogue will be evaluated for its quantum yield, LOD, and turn-on rates in response to ethylene gas. We predict that a neopentyl group will maintain a faster reaction rate, and the increased group size will limit probe decomposition. Additionally, this work will show the structure-activity relationship (SAR) which could be utilized to help design better and more sensitive probes.

Cadherin Conservation and Localization in Sponge Tissue (Porifera)

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Cell adhesion proteins are required to maintain the structural integrity of multicellular organisms. Cadherins are a highly conserved class of transmembrane proteins that form cell-cell adhesions known as adherens junctions. They are characterized by extracellular cadherin repeat domains that bind to other cadherin molecules and a cytoplasmic tail that is complexed with cytoskeletal proteins such as F-actin. Transcriptome sequencing in the sponge *Ephydatia muelleri* has shown that sponges express two putative classical cadherin homologs – members of the subfamily involved in homophilic adhesion at the adherens junction. Whether cadherin localization or function are conserved in sponge cell-cell junctions is unknown. Immunostaining and confocal microscopy were used to visualize cadherin localization in *E. muelleri* tissues using peptide antibodies raised against both extracellular and cytoplasmic epitopes of both expressed cadherins. Various fixation methods, as well as deglycosylation and antigen retrieval, were used to optimize antibody staining procedures. None of the antibodies labeled cell-cell junctions, but some showed differential staining patterns, labeling discrete structures (such as flagella) or cell types (migratory stem cells). Because there was no consistency between antibodies raised against different antigens from the same protein, we expect that these staining patterns are non-specific, but they may still be useful as cell-markers in future studies if their binding targets can be identified.

Therapeutic Potential of a Red Dragon Fruit, Hylocereus polyrhizus, Ethanol Extract in an hSOD1^{G93A} Mouse Model of Amyotrophic Lateral Sclerosis: Isolation and Characterization of Other Novel Red Dragon Fruit Extracts Enriched in Betacyanin Compounds

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Amyotrophic lateral sclerosis (ALS) is a progressive, fatal neurodegenerative disease that leads to death of upper and lower motor neurons via increases in factors like oxidative stress, neuroinflammation and dysfunctional antioxidant enzymes, amongst others. Progressive cell death results in a reduction of voluntary muscular function and eventual respiratory failure. Supplementation with natural compounds like flavonoids and other polyphenols has exhibited therapeutic effects in addressing some of the underlying mechanisms in ALS pathology. Betacyanins, a class of polyphenol, are found in high concentration in red dragon fruit (RDF) and have shown notable anti-inflammatory and antioxidant effects *in vitro*, but *in vivo* studies are lacking. The effects of RDF ethanol extract supplementation on survival, bodyweight, and motor function were assessed in an hSOD1^{G93A} mouse model of ALS. RDF flesh contains flavonoids and betacyanins, so a novel acid-base extraction of RDF was conducted and spectrophotometrically analyzed to aid in future procedures to investigate synergistic effects of these compounds. Additionally, a formic acid-ether extraction of RDF was completed with a crude purification via FPLC to determine concentration of betanin in fruit samples. LC-MS analysis was conducted in order to characterize the predominant compound(s) in all three extraction methods. Oral administration of RDF ethanol extract resulted in significant elongation of lifespan, preservation of bodyweight and increases in grip strength and motor function in treated hSOD1^{G93A} ALS mice. HPLC analysis determined relative betanin and isobetanin quantities in various extracts. Formic acid-ether extraction and purification exhibited high betanin and isobetanin yield confirmed by LC-MS analysis. Abundant deglycosylation of betanin in ethanol and acid-base extracts was confirmed via LC-MS analysis. Implications include a lack of knowledge of the actual molecular mechanisms of these polyphenolic compounds in mice, as well as the apparent degradation of betanin in the ethanol and acid-base extracts. Future experiments will address these issues.

Toxicity and Binding of TAR DNA-Binding Protein 43

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Present in many neurodegenerative diseases, specifically Amyotrophic Lateral Sclerosis (ALS), is a mutation of the protein TAR DNA-Binding Protein 43 (TDP-43). This protein is key in managing transcription of DNA and shuttling RNA through a cell. When a mutation in this protein occurs, healthy cells, specifically neurons, do not function and usually undergo apoptosis. When this occurs in the motor neurons of a patient, this causes ALS; if this occurs in the central nervous system, then Frontotemporal Dementia occurs. As such, discovering a therapeutic to target the mutation and toxicity of TDP-43 is one of the best methods to aiding patients. Before any drugs can be finalized, an understanding of TDP-43 toxicity is vital. To help characterize the disease qualitatively, toxicity is expressed and rescued using yeast as a neuronal model. After some microbiological work was done to express the toxicity of TDP-43 and the rescue capability of RNA, then biochemical work was conducted to explore the binding of TDP-43, both in dimers and RNA/DNA binding. As seen in the results, TDP-43 is seen to form a dimer, but it is still unclear where the dimerization occurs. Furthermore, TDP-43 does have binding capacity to both DNA and RNA, but further work needs to be done to create a construct of the protein that does not have a tag. Currently, the methods for producing a TDP-43 construct without a tag is currently underway, and this will help model the character of the protein.

An Exploration Of Admissions Inequalities at CU Boulder

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This project will address inequitable admissions processes in the University of Colorado (CU) system. We will focus on the low enrollment rates of low-income students in the system. Compared to public universities in other states, the CU system enrolls far fewer low-income students on average, which contributes to stagnation and generational poverty by severely limiting the educational and economic opportunities of Colorodans in impoverished communities. We will examine data from the Colorado Department of Higher Education, such as percentages of enrolled students who are Pell Grant recipients and/or come from families with combined incomes below the poverty line, to determine the extent of this disparity. Via interviews with staff and students at CU Boulder, the system's flagship institution, we will identify the enrollment barriers low-income students face and the types of supports or interventions that make college more accessible. Through this data, we will evaluate the effects of these low enrollment rates on the educational and economic outcomes of low-income students, which in turn, will help us understand how these issues should be approached through policy solutions.

The Effects of Reward Anticipation on Cognitive Control and Memory Encoding Processes: A Meta-Analysis

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Reward anticipation has been shown to influence cognitive control and memory encoding, but a wide variety of cognitive task designs have been used to investigate this relationship without being systematically accounted for when examining variability in reward effects on performance. To investigate effects of reward anticipation across both cognitive control and memory domains, and the influence of varying task paradigms and design elements within these domains, we are conducting a meta-analysis. Specifically, studies were extracted from the databases of Pubmed, Psycinfo and Web of Science. The search resulted in 124,905 studies. After removing duplicate studies and screening the titles, abstracts, and full texts against specific criteria (i.e., participant age), 161 studies remain. Of the remaining studies, 98 examine the effect of reward anticipation on cognitive control while the other 63 studies examine the effect of reward anticipation on memory encoding. The effect of the interaction between reward (high vs. low reward or high vs. no reward) with cognitive control or memory performance is currently being extracted from each study, along with specific design element data (i.e., time between reward cue and target presentation). The data will be inputted into the meta-analysis software "R" to determine the significance of the reward with cognitive control and the reward with memory performance interactions. We will then investigate how different task design elements may act as potential moderators affecting the strength of the relationship between reward and task performance. This research is the first of its kind using a meta-analysis approach to systematically quantify reward anticipation effects on cognition across both cognitive control and memory domains.

Discovering New Zinc Permeable Ion Channels

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Zinc is crucial to all living organisms as well as the second most abundant element in the environment. Zinc has been found to carry out many essential functions in the body and biological processes—ultimately, it functions as a signaling molecule for intercellular and intracellular processes including catalytic and structural pathways. Homeostasis of zinc is important to understanding how the molecule goes about physiological and pathological functions as it is strictly regulated in all aspects of the body from the cellular level up. Using the Qin lab's GZnP3 sensor, zinc can be recorded in nanomolar ranges, offering a better understanding of which ion channels are truly permeable or not. Here, the TRP family is tested using a baseline, zinc addition, and agonist to supposedly open up the ion channels for zinc to flow through. This has proved successful in many of the Trp channels explored and can lead to future work, include following zinc through homeostasis to understand the mechanisms behind it.

Peer Support Buffering for Post-Institutionalized vs Non-adopted Children on Psychosocial Outcomes

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The project aims to understand whether peer functioning can help to reduce the negative outcomes of early life stress in the form of institutional (e.g., orphanage or hospital) care. Previous research suggests that early life institutional care is considered an early life stressor due high risk for social, physical, and emotional deprivation (Maclean, 2003). Although it is known that high social support is associated with better social and emotional outcomes for teens, there is some evidence that youth adopted from institutions may not receive the same physiological benefits from social support as non-adopted teens raised in their biological families (Hostinar et al., 2015). However, the effectiveness of peer support on emotional and behavioral outcomes for post-institutionalized youth has rarely been explored. As a result, the current study examines whether peers can buffer from negative socioemotional and academic outcomes following stress. To investigate, 50 post-institutionalized adolescents, 33 non-adopted adolescents, and their primary parent came into the lab to answer a series of questionnaires. Parents and adolescents provided information about the number of negative life events in the past 12 months, peer functioning, and internalizing symptoms, externalizing symptoms, attention-deficit/hyperactivity disorder (ADHD) symptoms, and academic functioning. Overall, PI youth reported greater internalizing, externalizing, and ADHD symptoms, and poorer academic functioning. Greater peer functioning predicted lower internalizing symptoms and greater academic functioning. There was no evidence that peer functioning was less effective in reducing emotional and behavioral problems in the context of life stress for PI youth. The results suggests that future research should focus on how to support post-institutionalized youth and how to strengthen peer relationships to improve emotional and behavioral outcomes.

Trade Liberalization and the Social Determinants of Health: A Case Study of NAFTA's Impact on Mexico from 1994 to 2005

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Given the increased transnationalization of borders and economic interdependence between countries in the Global North and South, it is imperative to address how these trends impact the health and well being of the populations involved. The conventional neoliberal economic framework, however, falls short in explaining these dynamics due to its overemphasis of proximal determinants of health as direct consequences of commodification and free market activities. In congruence with those theoretical limitations, there is a limited assessment of more distal determinants – the social determinants of health (SDOH) – that are arguably more consequential for health and are interrelated with the dynamics of political economies. The relationship between trade liberalization and SDOH, therefore, deserves greater examination through said framework. This thesis seeks to address the aforementioned gaps by assessing the impacts of trade liberalization on SDOH within a case-study analysis of the North American FreeTrade Agreement (NAFTA) and its impact on Mexican SDOH pathways in the period between1994 and 2005. I identify three SDOH pathways for the analysis of NAFTA: employment,regulation, and agricultural commerce. By analyzing the intended impacts of NAFTA and Mexican policies, the quantitative primary, and the qualitative secondary data of the actual outcomes, I find that NAFTA's impact on SDOH was incredibly nuanced. The agreement produced mixed outcomes on an aggregate basis, but poorer outcomes for specific groups of people. But, the ultimate conclusion of this analysis is that the true impact of trade liberalization on SDOH cannot fully be examined in isolation, for each SDOH factor is inextricably linked with the other and is broadly interrelated with the domestic and global political economies.These findings have implications for further research in identifying SDOH as variables of concern within theories of political economy, as well as variables of concern for future trade and development policies.

Priming pain expression intensity influences intent to seek physical healthcare

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Increasing help-seeking behavior is extremely important as healthcare avoidance is associated with poorer healthcare outcomes (e.g., progression of cancer, worsening symptoms) (Taber et al., 2015). Previous work suggests healthcare avoidance may be associated with socialized norms (McDermott et al., 2018). Indeed, endorsement of masculine norms like restrictive emotionality (RE) predicts lower intent to seek help (Himmelstein & Sanchez, 2016). In two studies the current work examines the role pain expression and social norms play in self-reported intent to seek care. In Study 1 participants ($N = 128$) were randomly assigned to one of two pain expression conditions: exaggerated and suppressed. Participants then watched four 5-second-long videos of the same targets (two men, two women) experiencing pain. Conditions differed only in intensity of expression (i.e., exaggerated or suppressed). Afterwards, participants self-reported on a measure of trait RE. Participants subsequently self-reported their intent to seek care for common symptom arrays observed in emergency medicine (Weis et al., 2014). In Study 2 we aim to replicate Study 1. However, in Study 2, we test an alternate mediator (endorsement of RE norms), introduce a control condition, employ a larger stimulus set (20 targets), and recruit a larger sample (planned $N = 200$). Other aspects of the design will mirror Study 1. In Study 1, participants who viewed exaggerated (compared to suppressed) pain expressions subsequently reported greater intent to seek care ($p = .031$, $d = .48$). In Study 2, we will conduct a one-way ANOVA and mediation analysis to examine similar questions to Study 1. We predict participants in the exaggerated condition will express greater intent to seek care than those in the control condition than those in the suppressed condition. Taken together, these studies further our understanding of healthcare avoidance, pain disclosure, and emotional expression norms.

Vietnamese Diaspora

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Post-Vietnam war, hundreds of thousands of Vietnamese people migrated to the United States in order to escape political persecution and/or pursue the "American Dream." Using still photography and video, my project will document the experiences of many Vietnamese-Americans, pre- and post-migration, to the US. The project will revolve around portraying the stories of the Vietnamese culture and migration as an American story – not an international one. I was compelled to start this project as an exploratory exercise through photography and videography; on top of this, I am a first-generation Vietnamese-American and wanted to learn more about my family's history and community. For my project, I will concentrate on the substantial Vietnamese community in Denver – specifically my family's story. My process will be to utilize photographs and a documentary as a means to encourage sharing life experiences. So far, with this project, I have been compiling a three-part documentary and a complete photo collection of my grandparents' story and their motivations for moving here to America and how that has affected their lives thus far. My grandparents moved here to the U.S. 25 years ago and have been fostering the family that I am surrounded by today. Through this project, I have learned a lot about our family's history – from political prosecution in Vietnam to my grandpa dealing with depression over here, I have understood my family's history more than I have ever understood before. I hope to be able to continue this project and finish up the documentary when summer comes.

Interconnectedness with Nature and Human Emotional Response to Biodiversity

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Previous research has found that perceived interconnectedness with nature is associated with positive mental health and well-being. I tested the idea that self-nature interconnectedness is related to the degree to which nature affects human well-being using photos of riparian sites containing native and non-native vegetation, the latter mainly in the genus Tamarix. Tamarix has been a major focus of restoration activities in riparian systems in the southwest region of the United States. There is rising concern about the effects of aesthetic and biodiversity on human perceptions of the restoration, as well as human psychological well-being. Previous research has found that perceived biodiversity is positively correlated to its effect on mood; I tested the hypothesis that this impact of biodiversity would be dependent upon how connected to nature a person feels. To test my hypothesis, we collected data from students at the University of Denver using an online survey in which participants were asked to rate the attractiveness and biodiversity of a series of images. I used the Inclusion of Nature in Self (INS) scale to cognitively measure and quantify the participant's self-nature interconnectedness and the Positive Affect-Negative Affect Scale (PANAS) as a measure of participant mood pre- and post-survey. I found that rather than biodiversity, it was the participants own connection with nature that was associated with mood change, with more connected people having a positive mood shift and less connected people having less or even negative changes in mood over the course of the survey. These findings will help inform health care practitioners, ecologists and conservation biologists about how nature affects the human populations surrounding an ecosystem.

The Wolf's Bite: Investigating The Shapes Of Colliding Wind Regions In Wolf-Rayet Binary Star Systems

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Wolf Rayet (WR) stars are a type of evolved star at the end of its life that is shedding large amounts of mass from its outer layer. Sometimes, these stars form binary systems with very large main sequence stars, which cause even more gas from the WR star to be shredded. This interaction is thought to be the cause of the catastrophic cosmic gamma ray burst (GRB) events,where gamma rays, the most energetic form of the electromagnetic spectrum, are shot out across extreme distances. This explosion can depend on how much mass is being lost by the object,which can be discovered by examining the interaction between the two stars in the binary,particularly the gas being shed by the WR partner. The polarization of light coming from these systems is a great way to examine the various behaviors and qualities of different binary objects.That was the goal of this project, where I examined the object WR21 and WR31 in detail. I did this by using data our research team had collected from the RSS Spectropolarimeter located at the SALT observatory in South Africa. Then, using the coding program Python, I was able to examine the polarization of different lines throughout the orbital period that showed up in the spectrum (corresponding to what elements were present). I was able to examine various spectral lines of interest, such as C IV at 5805 angstroms and N IV at 7125 angstroms, and to see how these emission lines behaved differently from the continuum and to locate which place in the system they formed. From this, further analysis can be conducted to examine if the mass loss of this particular object is enough for it to be a GRB progenitor.

Childhood Experiences and Future Expectations During the COVID-19 Pandemic

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The current work investigates whether adverse childhood experiences (ACEs) and benevolent childhood experiences (BCEs) are associated with predictions of emotional states (affective forecasting) and future events (event prediction) during the COVID-19 pandemic. We hypothesized that higher ACEs and lower BCEs would independently be associated with predictions of a longer pandemic duration and more negative affective forecasting. We predicted the association between ACEs and predicting a longer pandemic and more negative affective forecasting would be weaker for individuals with higher BCEs than those with lower BCEs. Participants were undergraduate and graduate students (N = 502) who completed online questionnaires in May 2020 about mental health, the COVID-19 pandemic, and childhood experiences. Results indicated that BCEs were associated with forecasting of more happiness, less stress, and less loneliness. ACEs were not associated with affective forecasting. For those with less childhood adversity, an increase in benevolent childhood experiences was associated with predictions of a faster return to normal from the pandemic. While, among those with more childhood adversity, an increase in benevolent childhood experiences was not associated with predictions of faster return to normal from the pandemic. Our findings suggest that the number of BCEs may be more associated with predictions about the future than ACEs. Additionally, the number of BCEs may play an important role in influencing whether an individual potentially reacts to a major stressor with more optimism.

Environment, Endocrine Function and Embryos: How Exposure to Environmentally Compromised Regions Impact Critical Steps of Human Development and the Disproportionate Impacts of these Effects on the Global South

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Endocrine disrupting chemicals or EDCs are chemical compounds that interfere with the functioning of the endocrine system; a feedback loop of hormonal compounds released by the human body to regulate system functioning. This ranges from support for mood/emotions, development, growth, and plays a critical role in the development of human life. Through the context of pregnancy, hormones such as progesterone and oestrogen experience large fluctuations in their levels, and the placenta, a critical organ for a healthy pregnancy, functions as a temporary endocrine gland throughout the duration of gestation. The delicate balance of hormones from the pregnant individual to the developing embryo is essential to ensuring healthy psychological and physiological development. However, as our plant and our environment continue to become more polluted and shift into more extremes, these particularly specific and rather sensitive hormonal pathways of communication can be easily disrupted, compromising the ability for mother and fetus to transmit information, and creating potential increase of risk for subsequent issues in the time between fecundation through birth and onward. Toxic chemical exposures through air, soil, and water pollution, utilizations of endocrine disrupting materials such as specific plastics, textiles and personal care products, and other sources of contact to EDCs can all facilitate these disturbances. Through this paper, the effects of these exposures through the sensitive windows of pregnancy will be explored, as well as recognizing the disproportionate impact of these exposures on the global south from both a frequency and rate of EDC protection/production standpoint. Finally, an argument for the significance of these impacts paired with the lack of research surrounding these issues will be made, and advocation will be done to support the notion that these issues should be further investigated.

Editor's Notes
These abstracts have not been peer-reviewed.