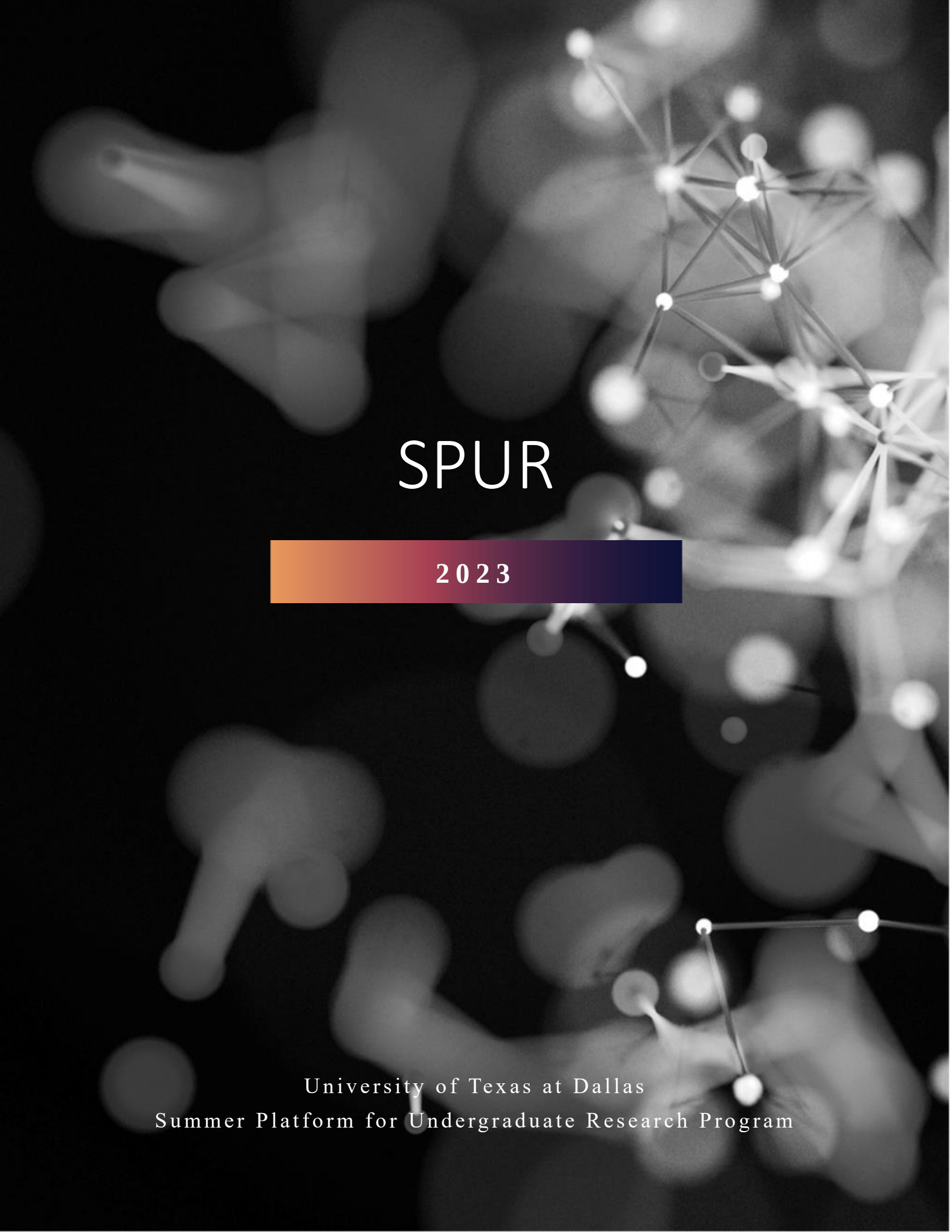

SPUR

2023

University of Texas at Dallas

Summer Platform for Undergraduate Research Program

ABOUT

The Summer Platform for Undergraduate Research (SPUR) is a unique, campus-wide symposium for students working on research at The University of Texas at Dallas. It is designed to be a "capstone" for student projects developed during the summer. The SPUR includes a number of on-going summer research programs at UTD, including the Clark Summer Research Program, the Bioengineering Undergraduate Research Scholars program, (NSF) Research Experiences for Undergraduates and others. In addition, students who are "unaffiliated" with an organized research program, whether they are working with a faculty member or not, can present at the SPUR. This is a great opportunity to learn how to present your research to a public audience and is also great for resume and CV building.

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SCHEDULE

Edith O'Donnell Lecture Hall, *ATC 1.102*

11:30 am **Welcome – Dean Skinner**
11:35 am **Words from President Benson**
11:40 am **Keynote Speaker – Dean Adams**
12:15 pm **3 Student Presenters:**
Nancy Tran
Jesus Sotelo
Jeongsik Park

Davidson-Gundy Alumni Center

1:00 – 2:15 pm **Poster Session 1 (even numbers)**
2:15 – 3:30 pm **Poster Session 2 (odd numbers)**


Dr. Stephanie Adams

Keynote and Oral Presentations

KEYNOTE

Dr. Stephanie G. Adams
Dean of the Erik Jonsson School of Engineering and Computer Science
Lars Magnus Ericsson Chair in Electrical Engineering

Dr. Stephanie G. Adams is an engineering education thought leader who has served as the fifth dean of the Erik Jonsson School of Engineering and Computer Science since 2019. She is also a professor of systems engineering.

Adams is a pioneer in engineering education. In 2003 she received a National Science Foundation (NSF) Faculty Early Career Development (CAREER) award to research effective teaming in the engineering classroom. In addition to teamwork and team effectiveness, her other areas of research expertise include broadening participation in STEM (science, technology, engineering and mathematics), faculty and graduate student development, global education, and quality control and management.

Adams' passion and work toward greater inclusion in STEM derives, in part, from her belief in the importance of engineering to society.

STUDENT PRESENTERS

Nancy Tran
Jesus Sotelo
Jeongsik Park

Nancy Tran is a senior biology major. Tran will present: "Optimization of PhotoThermal Therapy for Enhanced Immunogenic Cell Death."

Jesus Sotelo is a senior neuroscience major. Sotelo will present: "Harnessing the Hidden Potential: Exploring Solutions from Nature to Combat Chronic Pain."

Jeongsik Park is a senior computer science major. Park will present: "Exploiting Background Knowledge and Implicit Messages for Hateful Meme Detection."

ABSTRACTS

(1)
Identification of Nerve Tissue with Hyperspectral Imaging for Surgical Purpose

Michelle Bryarly, Minh Tran, Baowei Fei
Department of Bioengineering, The University of Texas at Dallas

For medical procedures that require acute attention to detail, differentiation between nerve and surrounding tissue is crucial. Medical imaging techniques can enhance the contrast between types of tissue beyond what the human eye can visualize. Whereas an RGB image captures 3 bands within the visible light range (around 400 nm to 700 nm), hyperspectral imaging (HSI) can acquire many bands in wavelength increments that highlight regions of an image across a wavelength spectrum. With HSI, a method can be developed to identify types of tissue in an image using spectral signatures. Endmember classification, which takes a spectral signature acquired from images and outputs a distance map of spectral similarity, has been used in other applications such as agriculture, but little research has been done on the exploration of nerve endmembers. Our goal was to capture HS images of tissue to create a spectral library that can be used to differentiate between pixels containing nerves in an image. HS images were acquired with cameras incorporating the visible light range, from 399- 1001.74 nm, as well as the near infrared (NIR) range, from 897.85-1700.7 nm. Several images were captured containing only nerve tissue, as well as images with a variety of different tissues. We found distinct signatures for nerve, muscle, and fat in the visible light spectrum that we used to successfully classify types of tissue found. We hope that this method, if implemented successfully, can be applied to improve medical surgeries by enhancing a surgeon's ability to distinguish nerve tissue.

(2)
ChaChaCha: Live-Cell Fluorescent Sensors to Measure Activation of G-Protein Coupled Receptors

Precious Grace Castillo[1], Medel B. Lim Suan Jr.[2], Zain Syed[2], Ajay Tunikipati[2], Jaimahesh Nagineni[2], Rodrigo Raposo[2], Mindy Li[2], Giulietta Peleg-Baldino[2], Dave Dingal[2]
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G-protein coupled receptors (GPCRs) are membrane receptors that transduce various extracellular ligands into intracellular responses. GPCRs are involved in many cellular processes, and more than 30% of FDA-approved drugs target GPCRs. Measurement of GPCR signaling activity has been challenging due to the complexity of its signaling cascades. Here we present the ChaChaCha system, a fluorescent sensor to measure GPCR activation in live cells. The sensor utilizes split fluorescent proteins and novel proteases. Each protease cleaves a unique 7-amino-acid sequence in between beta-arrestin 2 (arrb2) and the first 10 beta strands of the fluorescent protein, sfCherry (sfCherry1-10). Upon proteolytic cleavage, sfCherry1-10 is released and translocated into the cell nucleus, where the 11th beta strand of sfCherry (sfCherry11) resides. Cleavage-mediated reconstitution of the sfCherry1-10 and sfCherry11 components leads to sfCherry fluorescence in the nucleus. We expressed the engineered proteases and their cognate cleavable substrates in human embryonic kidney (HEK293T) cells. To determine whether the engineered proteases are functional, we imaged for sfCherry fluorescence in the nucleus after 24 hours. Quantitative analysis of sfCherry fluorescence intensity suggests that the proteases have varying cleavage rates. Finally, the best-performing

proteases were fused to GPCRs. To determine if the GPCR-protease fusion can be activated with extracellular ligands, we measured GPCR activation based on nuclear sfCherry fluorescence. Future studies include improving the catalytic rates of our novel proteases and measuring multiple GPCRs in vitro and in animal models.

(3)
The effects of cognitive dual task on stability during gait and sit-to-walk

Marvin Alvarez
Department of Bioengineering, The University of Texas at Dallas

Understanding the relationship between movement stability and cognitive dual task (DT) in a person can determine neurological deficiency and fall-risk vulnerability for individuals. Falls most commonly occur when an individual has a sudden change of movement and momentum such as transitioning from a seated position to a walking form, known as sit to walk (STW). Few applicable literatures cover the issue of DT in STW studies. The purpose of this study is to compare balance variability in gait and STW initiation while performing DT by calculating the foot strike and toe-off angle between the center of mass (COM) and the lateral ankle of a foot from the sagittal plane. Participants (n = 10), healthy adults aged 18 – 44 years old, performed six gait initiation trials and six sit-to-walk trials, each having three single-task and three dual-task trials. Data was collected using infrared cameras with a 3D motion capture system (Vicon) and force plates (Kistler). Data analyzed showed that although the toe-off COM-ankle angle was similar, participants would have a foot strike COM-ankle range decrease of 0.37° to 1.57° in DT walking trials as compared to ST walking trials. Additionally, STW trials showed that mobility was decreased by 0.76° to 3.38° at toe-off and 0.52° to 1.66° when transitioning from ST to DT trials. In general, a correlation between dual-task and COM-ankle angle exists regarding a person's movement. However, a larger pool of participants will be necessary to solidify a proper conclusion.

(4)
Influence of Sex on Bodily Expression of Emotion through Biomechanical Analysis

Sohila Elfar
Department of Bioengineering, The University of Texas at Dallas

Our emotions can have a significant effect on our physical behavior, there are many studies that show differences between how males and females regulate their emotions. There are however scarce studies showing the differences in how emotions affect movement between male and female. This study aimed to explore the impact of different emotions on movement patterns, specifically focusing on spatial-temporal measures and sit-to-walk hesitation, and how these effects differ between males and females. Current studies show that women regulate their emotions more apparently and obvious than males thus we hypothesize that the results would lead to quicker and more amplified spatial temporal measures among female and male. We used a 16-camera motion capture technology to capture motion data across five different emotions; happiness, sadness, fear, anger, and neutral. We analyzed 6 participants, 3 of which were males and three females. The study focused on spatial temporal measurements; gait speed, cadence, stride length, stride time for walking trials, and hesitation for sit-to-walk. As an example, the averages for gait speed obtained from the male participants were 1.495 m/s for anger, 0.820 m/s for sadness, 1.243 m/s for neutral, 1.236 m/s for happiness, and 1.147 m/s for fear. The averages for gait speed obtained from the female participants were 1.316 m/s for anger, 1.326 m/s for sadness, 1.290 m/s for neutral, 1.351 m/s for happiness, and 1.317 m/s for fear. In conclusion, we found that for emotions of sadness, happiness, fear, and neutral females experienced higher gait speed than males.

(5)
Improving the Efficacy of mRNA Delivery Through Endosomal Escape Using Light Activated Lipid Nanoparticles

Maxwell Quaye, Chanda Bhandari, Girgis Obaid
Department of Bioengineering, The University of Texas at Dallas

mRNA vaccines, such as the one used for COVID-19, have been developed to fight against viral infections within recent years. These vaccines work by taking an RNA sequence from a specific protein of the virus and introducing that sequence to our cells. Our cells then take that sequence and transfect the sequence to reproduce the protein so that our immune system learns and produces antibodies to fight similar future infections. The limitation of this strategy is the effectiveness of the mRNA in reaching the cytosol of the cell, for it to then be transcribed and translated. A majority of the mRNA that enters the cell becomes entrapped in endosomal compartments and is lost through endolysosomal degradation. To address this limitation, we aim to increase the efficiency of mRNA delivery using light activated lipid nanoparticles (LALNs). These LALNs operate by combining biocompatible lipid nanoparticle carriers to encapsulate the mRNA and light responsive molecules called photosensitizers. When exposed to particular wavelengths of light, the LALNs create a photochemical reaction, disrupting the endosomes, leading to mRNA releasing from both the LALNs and the endosomes safely. The LALNs allow for more accurate timing of mRNA release, location-specific delivery of mRNA, and an overall increase in mRNA delivery efficiency. Our preliminary experiments include synthesis and characterization of LALNs and a cytotoxicity assay to assess the toxicity of the LALNs in vitro. Our future perspective will include experiments to check the increase in endosomal escape of the mRNA in in vitro and in vivo settings.

(6)
Compression and micro-indentation testing on the murine vagina

Jorge Rodriguez[1], Lily Buchanan[2], Somdutta Chakraborty[2], Victor Varner[3], Kristin Miller[2]
[1]University of Arkansas, [2]The University of Texas at Dallas, Department of Bioengineering, The University of Texas at Dallas, Department of Mechanical Engineering, The University of Texas at Dallas, [3]Department of Obstetrics & Gynecology, University of Texas Southwestern Medical Center

Pelvic organ prolapse is characterized by the descent of organs from their normal locations due to failure of the supporting tissues, instigating a protrusion into the vaginal canal. This disorder negatively impacts the quality of life by limiting proper pelvic organ function, leading to symptoms such as discomfort and pain; however, its etiology is not fully understood. Towards this end, a better understanding of the local biomechanical properties of the vagina will help identify the causes of tissue weakness and subsequent prolapse development. To accomplish this, compression and micro-indentation methods were explored in the interest of developing a protocol to evaluate the local micromechanical properties of murine vaginal tissue from CD-1 mice, which are commonly used for prolapsing studies. These protocols were complemented by evaluating commercial pelvic floor meshes used in prolapse surgical interventions. The experimental protocols developed herein enable the quantification of local mechanical properties to identify the structural and mechanical mechanisms of prolapse and mesh failure. The aim of this project is to provide a valuable tool that can be useful in the assessment and determination of regional differences in the mechanical features of the vagina and to contribute to other research on problems related to pelvic floor disorders.

(7)
Expanding the substrate sequence alphabet of novel proteases to control signaling proteins in vivo

Jaideep Kaur, Medel Lim Suan Jr., Mustafa Alrawi, Nitin ChikkodiNashrah Sadaf, Adam Ramadan, Saif Syed, P.C. Dave P. Dingal
Department of Bioengineering, The University of Texas at Dallas

Enzymes drive a variety of cellular processes. Potyviral proteases are a class of enzymes that can cleave a unique 7-amino-acid (heptapeptide) sequence in a target protein. Highly-specific proteases allow us to regulate or degrade proteins. Here we develop the Synthetic Processing System (SynPro), a library of novel secreted proteases engineered to control secreted proteins in animal cells. As proof of principle, we engineered Potyviral proteases to cleave and activate Vg1, a secreted signaling protein. Vg1 and another protein, Nodal, form secreted heterodimers that induce the formation of the mesendoderm, a population of cells that gives rise to muscle, bone, and blood tissues. We previously established that cleavage of Vg1 is required for zebrafish embryos to form these tissues. For SynPro enzymes to recognize Vg1, its wild-type cleavage site sequence ('RSRRKR') was replaced with a heptapeptide sequence specific to an enzyme. With the aid of Alphafold2 to model structures of the Synpro enzymes, we generated mutations that render SynPro enzymes to function in the endoplasmic reticulum (ER) where Vg1 is found. To test enzyme function in the ER, we injected SynPro enzymes and SynPro-cleavable Vg1 in embryos lacking Vg1. We then scored the number of rescued zebrafish embryos to determine whether the enzyme efficiently recognized the synthetic cleavage site in Vg1. Our findings suggest that we can engineer enzymes to control secreted signaling proteins at both cellular and whole-animal levels. We plan to extend these promising results to engineer SynPro enzymes that target other signaling proteins or that can degrade disease-causing proteins.

(8)
Development of miRNA-based Disease Detection Platform Using Loop-mediated Isothermal Amplification Reaction

Aakriti Jaiswal, Fagun Shah, Rudra Krishnamurthy, Taek Kang, Leonidas Bleris
Department of Bioengineering, The University of Texas at Dallas

MicroRNAs (miRNAs) are essential regulators of mammalian gene expression that bind to mRNAs and prevent the translation to proteins. MicroRNAs are also useful biomarkers, as dysregulated miRNA expression is a key trait in various diseases. However, due to their low abundance in clinical samples, amplification is necessary for detection. Quantitative polymerase chain reaction (qPCR) is a commonly used method for miRNA amplification and detection, but it is costly, time-consuming, and has high instrumental requirements. The loop-mediated isothermal amplification (LAMP) reaction is an alternative method for amplification that utilizes several specialized primers. Compared to qPCR, the LAMP reaction is cheaper, quicker, and has lower instrumental requirements. In this study, we developed a miRNA-based disease detection platform using LAMP. Firstly, we identified the disease-associated miRNA from literature and its genomic location to amplify the precursor miRNA. Using this DNA template, we synthesized the corresponding RNA via in vitro transcription to serve as a template for the LAMP reaction. To facilitate the analysis and recovery of the amplified product, we incorporated restriction enzyme sites within our specialized LAMP primers. To test the sensitivity of the reaction, we tested varying concentrations of the RNA template and determined the minimum time for amplification. We applied our approach to different disease-associated miRNAs. In the future, we plan to validate the platform using clinical samples and develop strategies to detect multiple miRNAs simultaneously in a single reaction.

(9)
Engineering Solitary Fibrous Tumor Cell Models for ImmunotherapyEngineering Solitary Fibrous Tumor Cell Models for Immunotherapy

Rudra Krishnamurthy, John Nguyen, Leonidas Bleris, Heather Hayenga
Department of Bioengineering, The University of Texas at Dallas,

Solitary Fibrous Tumors (SFTs) are rare tumors of mesenchymal origin, affecting 0.6 per million individuals annually. The prognosis for patients with SFT is poor and no systemic therapy exists. Due to the disease's rarity, a suitable SFT cell model to explore treatments is lacking. The oncogenic driver of SFT is a nonhereditary fusion of the NAB2 and STAT6 genes on chromosome 12. We have generated a stable fibroblast cell line harboring a distinct NAB2-STAT6 fusion using Clustered Regularly Interspaced Short Palindromic Repeats (CRISPR) technology. Upon the introduction of this mutation, the cells exhibit oncogenic properties consistent with literature descriptions of SFT. This cell line was made for the purpose of developing a T-Cell Receptor Therapy (TCR) for SFT. In TCR, T-Cells are engineered to recognize and target specific NAB2-STAT6 fusion-derived antigens. When creating the NAB2-STAT6 fusion, a hygromycin-resistance gene (HygR) was introduced for drug selection. To make the cell model amenable to editing for immunotherapy, the HygR gene was removed through transfection with a Flippase construct. The cells were subsequently sorted for the fluorescent reporter mKate2 to isolate the transfected population. Once the HygR gene is removed, we will stably integrate the proper HLA-type in our candidate fibroblast cell model to identify these SFT-specific antigens for T-Cell targeting. Our cell lines will be pivotal for understanding the cancer biology of this sub-type of sarcoma and will catalyze progress towards much-needed therapeutic options.

(10)

A Method for Rodent Restraint to Enable Vagus Nerve Stimulation for Urinary Dysfunction After Spinal Cord InjuryA Method for Rodent Restraint to Enable Vagus Nerve Stimulation for Urinary Dysfunction After Spinal Cord Injury

Sahana Dhananjayan[1], Juliet J. A. Addo[1], Mia J. Sargusingh[1], Philippe Zimmern[2], Margot Damaser[3], Seth Hays[1], Ana G. Hernandez-Reynoso[1]
[1]*Department of Bioengineering, The University of Texas at Dallas,* [2]*University of Texas Southwestern,* [3]*Glickman Urological and Kidney Institute*

Spinal cord injury (SCI) causes severe symptoms, including urinary dysfunction. While conservative treatments offer relief, they increase the risk of recurrent urinary tract infections with a mortality rate of approximately 15% in SCI patients. Therefore, novel therapies are necessary to enhance quality of life. Vagus nerve stimulation (VNS) effectively improves motor and sensory function by promoting targeted neuroplasticity during SCI rehabilitation. This study aims to strengthen neural urinary control by pairing VNS with bladder function. To enable awake urodynamics and timed-VNS in a rat model of SCI, a restraining device for transurethral catheterization is required as anesthesia disrupts bladder reflexes and micturition. We compare traditional cylinder restraints used for suprapubic catheterization to a cloth-based restraint system in female Sprague-Dawley rats (N=12). Animals were anesthetized with isoflurane for transurethral catheterization before applying the restraints. We assessed the animals' tolerance to the restraints, without previous training, for up to 15 minutes, recording any adverse events. The events were categorized as minor and severe. Results indicated animals tolerated approximately 10.67±5.01 min in the cylinder restraint and 15±0 min in cloth-based restraints, with no statistically significant difference ($p=0.06$). Both restraints had minor adverse events (agitation, stress). The cylinder restraints had severe adverse events (choking, bleeding, loss of circulation, pain, etc.), accounting for 50% of events. Cloth-based restraints had 0% adverse event rate making them the preferred restraint for this project. Future studies will explore 60-minute restraint training with catheterization and evaluate the hypothesis.

(11)

Evaluating the Effect of Acetate Supplementation in Vitro on Glioblastoma Viability and Lactate Production Under Conditions of Metabolic Stress

George Kidane, Kathleen Domalogdog, Daniel Anable, Lloyd Lumata
Department of Physics, The University of Texas at Dallas

The Warburg effect characterizes cancer cell metabolism, whereby increased glucose uptake yields preferential lactate production during glycolysis. Cells use lactate to promote viability, which in turn sustains the tumor microenvironment. Replacing glucose with a carbon source used for purposes primarily other than viability reduces lactate. One example is acetate, which is used for lipogenesis. However, low serum content and low oxygen in vitro can induce a state of metabolic stress which allows some types of cancer to convert acetate into lactate. This phenomenon has not been previously investigated in glioblastoma, an aggressive form of brain cancer. The purpose(s) of our study is to determine how well stress supports viability and the amount of lactate produced under stress in glioblastoma. We hypothesized viability would not significantly decrease and lactate production would not be significantly less than glucose-derived lactate production. All experiments were performed with the SFXL glioblastoma cell line. We used single and time-point colorimetric assays and compared the absorbance of glucose-treated cells grown in normal oxygen to cells under stress to measure viability. We grew cells with either [1-13C] glucose or [1-13C] acetate in normal and low oxygen and analyzed cell and media extract metabolic profiles using 13C nuclear magnetic resonance spectroscopy to determine whether glioblastoma can use different carbon sources for lactate production. We found viability significantly decreased under stress, and lactate production under stress was significantly lower compared to glucose-derived lactate production. These data suggest limitations in glioblastoma metabolism plasticity, which will inform future studies on therapeutic targets.

(12)
Ratio of Inhibitory to Excitatory Interneurons in Human Spinal Dorsal Horn

Nethra Selvakumaran, Theodore Price
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Pain is defined by the International Association for the Study of Pain (IASP) as “An unpleasant sensory and emotional experience associated with, or resembling that associated with, actual or potential tissue damage”. Chronic pain is that which persists for longer than 3 months and a third of chronic pain patients are unresponsive to current treatments, therefore the need for effective analgesics is becoming increasingly obvious. Although cardiac infarctions, stroke and diabetes have relatively high mortality rates, chronic pain is the primary source of distress and disability. Interneurons comprise over 95% of all neurons in the spinal dorsal horn (SDH) and modulate sensory information transmitted via primary afferents. These signals are either facilitated or suppressed by two subclasses of interneurons: excitatory and inhibitory interneurons, respectively. In rodent models of chronic pain, the ratio of excitation versus inhibitory tone in the SDH is altered through increased excitability and/or disinhibition in specific neural networks, causing pain to become more harmful than helpful. Whilst interneuron populations have been quantified in rodents, this analysis has not been undertaken before in the human spinal cord. We performed RNAscope analysis for Pax2, a transcription factor found in inhibitory interneurons, and VGluT2 (Slc17a6), a glutamate transporter found in excitatory interneurons, on spinal cord sections from a male and female organ donor. We found that among 698 DAPI-stained nuclei, 64 were Pax2+ and 155 were VGluT2+, resulting in an approximate ratio of 1:3 inhibitory to excitatory interneurons, similar to the published ratio in rodent SDH.

(13)
Auditory Learning and Perseverative Behaviors in a Rodent Model of Autism

Maria Solano, Crystal Engineer
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Autism spectrum disorder (ASD) is a neurodevelopmental disorder associated with difficulties in executive functions. In cognitive assays, such as the Wisconsin Card Sorting Task, individuals with ASD show perseverative errors and difficulty set-shifting. Similar deficits in associative learning have been observed among mammals prenatally exposed to valproic acid (VPA), who take longer to relearn new associations and make more perseverative errors than control groups. Here we test whether VPA-exposed rats demonstrate associative learning deficits in a complex sound reversal learning task. Two groups of rats were trained in a go/no-go auditory task to identify and discriminate the speech sound /dad/ (CS+) from a similar distractor sound /sad/ (CS-). Once the rats achieved expertise on the discrimination task, the CS+ and CS- sounds were switched, requiring the rodents to learn new associations. After three weeks, the animals proceeded to discriminate additional consonant pairs: D/B, D/G, and D/T. Although data collection is still in progress, the results of the study will further characterize the VPA model of ASD and contribute to our understanding of the relationship between cognition and sound discrimination. By establishing a model of cognitive inflexibility similar to what is observed among humans with ASD, we can explore interventions that encourage cognitive flexibility in a preclinical setting.

(14)
Paradoxical Effects of Inhibition of the Locus Coeruleus on Fear Memory in Rats

Chelsea Edosomwan, Debora Calderon, Christa McIntyre
Department of Neuroscience, The University of Texas at Dallas

The locus coeruleus-norepinephrine (LC-NE) system plays a crucial role in learning, memory, and extinction processes. The LC utilizes norepinephrine as a neuromodulator to facilitate encoding and retrieval. However, the exact involvement of the LC-NE system in extinction of fear memories is unclear. Prior studies have demonstrated that vagus nerve stimulation (VNS) enhances the extinction of fear memory in rats by replacing fear memory with a safe memory. We recently found that inhibiting the LC during exposure to fear conditioned stimuli impeded the VNS-induced enhancement of fear memory extinction. While our results supported the involvement of the LC-NE system in VNS effects on extinction memory, LC inhibition alone enhanced extinction. These findings highlight the complex role of the LC-NE system in fear memory modulation during exposure therapy. To gain further insights into the effects of LC inhibition on extinction, we tested two hypotheses. Firstly, we hypothesized that LC inhibition has an anxiolytic effect, which we assessed using the open field test and elevated plus maze. Secondly, we hypothesized that intermittent inhibition of the LC enhances conditioned fear extinction by producing phasic LC activity. To test this, we inhibited the LC for 30 continuous seconds during exposure to the conditioned stimulus. Our results showed that LC inhibition is not anxiolytic, and that LC-NE inhibition did not enhance extinction memory by producing phasic activity. Rather, our results indicated that LC-NE inhibition enhances normal extinction. These results warrant further investigation into the different mechanisms behind VNS-paired extinction and normal extinction.

(15)
Role of Readthrough-Extended AQP4 (AQP4X) in Huntington's Disease

Natalia Hernandez, Prarthana Suresh, Darshan Sapkota
Department of Neuroscience, Department of Biological Sciences, The University of Texas at Dallas

Huntington's Disease is a neurodegenerative disease caused by a polyglutamine repeat expansion in exon 1 of the huntingtin gene (HTT), which results in the intracellular aggregation of mutant huntingtin protein. Various therapeutic approaches have attempted to lower huntingtin aggregate expression with limited success. Here, we explore a new target, Aquaporin-4 (AQP4). AQP4 and its uniquely perivascular, readthrough-extended isoform, AQP4X, maintains a homeostatic role in the brain by means of the glymphatic system: a non-selective passive waste clearance via cerebrospinal fluid tract. Previously, our lab has demonstrated that AQP4 and AQP4X are differently expressed in various neurodegenerative diseases, including Alzheimer's disease. However, it remains unknown whether AQP4/AQP4X expression levels and patterns are affected in Huntington's Disease. Using immunofluorescence and western blotting, we aim to study the cross-modulation between AQP4, AQP4X, and mutant huntingtin accumulation in the Huntington mouse model, ZQ175 from three to nine months of age. To increase the rigor of ongoing experiments, we are currently employing polyglutamine-specific antibodies for western blot as well as techniques for antigen unmasking in immunofluorescence. We are moving forward with future experiments that aim to correct and properly modify conflicting variables in order to acquire reproducible data. Future experiments aim to clarify the role of AQP4 and AQP4X in Huntington's disease, which could potentially help develop a therapeutic approach for huntingtin clearance.

(16)
Effects of Acute Cocaine Withdrawal on Anxiety in Rats

Neissa Molin, Chris Driskill, Lily Vu, Sven Kroener
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Cocaine use disorder is a health burden that affects millions of people around the world and is characterized by its difficulty to treat due to the high rate of relapse. An incubation of anxiety phenotype induced by cocaine withdrawal is a common occurrence and major contributor to relapse. Treatment of which often involve extinction learning, the process of gradually severing the association between cues and cocaine use. Previous research from our lab has concluded that Vagus Nerve Stimulation (VNS) facilitates extinction learning and consequently reduces drug seeking. However, the exact mechanisms of the effects of VNS on drug-seeking are unclear. Thus, it is unknown whether VNS has an effect on withdrawal-induced anxiety. A pilot study using a yoked saline model of cocaine self-administration is currently underway in order to determine whether acute withdrawal from cocaine seeking induces anxiety-like behaviors in rats. Preliminary to this, a validation study was completed in order to establish the methods that will be used for these future experiments. Three behavioral measures were executed: open field, marble burying, and novelty suppression feeding. These behavioral paradigms were established and validated in a blinded study by using an alpha-2-antagonist, Yohimbine hydrochloride, in order to pharmacologically induce anxiety in both male and female rats. Future directions for this study are to explore the effects of VNS paired with extinction or abstinence, respectively, on anxiety and relapse rates in cocaine seeking rats. This will provide a complementary explanation for the mechanism of how VNS reduces relapse rates.

(17)
Cannabinoid Receptor 1 (CB1R) on Sensory Neurons Does Not Prevent Analgesia During Inflammatory Pain nor Alters Anxiety

Sydney J. Lawley, Audrey R. Green, Michael D. Burton, Michael D. Burton
Department of Neuroscience, The University of Texas at Dallas

Amidst the opioid crisis without a safe and efficacious long-term solution, researchers are turning to cannabinoids as a possible answer. Cannabinoids, such as tetrahydrocannabinol (THC), have been used as an analgesic for millennia. Cannabinoid receptor 1 (CB1R) on sensory neurons in the dorsal root ganglia have been postulated to be critical for producing analgesia. However, conflicting analgesic results have been observed in both clinical and preclinical studies, and it is unknown how anxiety confounds results. We hypothesize that CB1R on sensory neurons does not alter analgesia or anxiety. To create a mouse model with CB1R expression removed in sensory neurons, CB1R flanked by loxP sites was deleted in a Cre-lox manner using a Cre localized to the promoter of Nav1.8 sensory neurons. The analgesic effect of exogenous cannabinoids in the absence of sensory neuron-specific CB1R was assessed using mechanical and thermal sensitivity measures after administration of the local inflammatory agent carrageenan and the synthetic cannabinoid WIN55,212-2. An Open Field assay was used to investigate any basal strain and sex differences in anxiety and spontaneous locomotion that may influence nociceptive behaviors. The absence of CB1R on sensory neurons did not significantly diminish the analgesic effect of WIN55,212-2 on mechanical or heat stimuli. Removal of CB1R on sensory neurons did not change basal levels of anxiety and locomotion in either sex. Further research should continue to assess the action of cannabinoids localized to a peripheral target to determine if cannabinoids could be a safe and effective alternative to current pain therapeutics.

(18)
Harnessing the Hidden Potential: Exploring Solutions from Nature to Combat Chronic Pain

Jesus Sotelo[1], Jaini Paltian[1], Lakeisha Lewter[1], Savannah Grace Anez[2], Joshua Kellogg[2], Kevin Tidgewell[3], Benedict Kolber[1]
[1]*Department of Neuroscience, The University of Texas at Dallas* [2]*Pennsylania State University* [3]*University of Kentucky*

Chronic pain affects 1 in 5 individuals worldwide, necessitating interventions due to limitations of current analgesics, notably opioids. Addiction related to opioids remain a major concern with around 100,000 U.S. citizens experiencing fatal-overdoses last year. While exploration of transformative natural compounds is uncommon in the scientific community, identifying novel therapeutic analgesics remains a clinical need. This study investigates therapeutic properties of two natural products: Monotropa Uniflora (ghost pipe) and veraguamide analogs from Cyanobacteria. We hypothesized that these compounds would display therapeutic potential with in vitro calcium imaging and in vivo behavioral assays. Calcium imaging experiments utilized dorsal root ganglion (DRGs) from mice expressing genetically encoded GCaMP6f, a calcium indicator. To assess therapeutic potential of these compounds, we observed their effect on KCl and capsaicin-induced neuronal activity in DRGs, respectively. In vivo behavioral tests were performed using a mouse model of inflammatory pain (i.e. Complete Freund's Adjuvant). We evaluated the effect of ghost pipe (15 mg/kg, i.g.) on mechanical and thermal sensitivities using von Frey and Hargreaves tests, respectively. Results from in vitro experiments show that ghost pipe has no effect on KCl-induced activity in DRGs; however, in vivo, it significantly reduces thermal but not mechanical sensitivity compared with vehicle. We also investigated the in vitro effect of veraguamide analog (AR3.005), which significantly reduces capsaicin-induced neuronal activity in DRGs. Collectively, findings from this study highlight and support the use of natural compounds as potential analgesics. Future investigations will explore different in vitro and in vivo mechanisms involved in their analgesic effects.

(19)
Effects of Vagal Nerve Stimulation on Recurrent Laryngeal Nerve InjuryEffects of Vagal Nerve Stimulation on Recurrent Laryngeal Nerve Injury

Arlin Khan[1], Robert Morrison[1], Ananya Bommakanti[1], Harsha Haridas[1], Ted Mau[2], Adrianna Shembel[1]

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Recurrent laryngeal nerve (RLN) injuries can occur during surgeries in the neck and chest, leading to unilateral vocal fold paralysis (UVFP). UVFP causes vocal communication deficits and dysphagia (trouble swallowing). While the RLN can spontaneously reinnervate after injury, the crossed reinnervation of abductor and adductor RLN motor fibers impairs mobility of the laryngeal muscles that open and close the vocal folds. Currently, there are no validated animal models of vocal deficits post-RLN injury and no therapies to restore laryngeal motor function after an RLN injury. In Aim 1, we validated a rat model of chronic vocal deficits post-RLN injury in 9 Long Evans rats. In Aim 2, a second set of 5 female Long Evans rats were split into two groups: 2 animals received vagus nerve stimulation (VNS) paired with swallowing rehabilitation after RLN injury to improve vocal fold mobility while 3 additional animals received swallowing rehabilitation only (sham group). Outcomes for both study aims were ultrasonic vocalization (USV) acoustics and vocal fold mobility on laryngoscopy. All rats in the chronic model had vocal and laryngeal deficits at their terminal endpoint (Aim 1). Vocal fold mobility significantly improved in the VNS-paired animals compared to the sham group (Aim 2). These promising preliminary findings suggest USVs and laryngoscopies can be used to track changes in chronic RLN injury model and that VNS may be a robust approach to laryngeal rehabilitation post-RLN injury.

(20)
Examination of Potential Gender Differences Across Six Developmental Measures on the Ages and Stages Questionnaire in Predominantly Spanish Speaking Households

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The first few years of life represent a critical period for children's cortical and behavioral development. Studies have shown that a child's ability to meet early developmental milestones predicts academic preparedness and has a long-term impact on overall success. This highlights the need to track a child's progression to ensure early identification of potential delays. As diversity of sample populations increase, studies focus on parental educational attainment, socioeconomic status, or learning strategies to explain large variability in scores on developmental assessments. However, few studies test for gender differences in ASQ scores. The current study used the Ages and Stages Questionnaire (ASQ), a screening tool used by primary caregivers and clinicians to evaluate children, 2-60 months old, across six developmental domains. Respondents answer questions about a child's ability to complete tasks and the responses determine if a child meets expectations, needs monitoring, or needs referral. Chi-squared tests were run on ASQ screening data to evaluate if girls and boys score differently across ASQ domains. The sample (n=746) is predominantly Spanish-speaking children from low SES homes who participated in The Center for Children and Families programs. Results indicated that gender was significantly associated with an increased risk in ASQ communication ratings ($\chi 2 = 7.11$, $p = 0.0285$) and in ASQ personal social ratings ($\chi 2 = 7.35$, $p = 0.0043$), with boys being more likely to meet the criteria for referral than girls. Fine motor, gross motor, problem solving, and social emotional skills, all showed no significant association for increased risked based on gender ($p > .24$).

(21)
Exploring Affective Variability: Emotion Valence, Mother-Adolescent Comparisons, and Links to Mental and Relational Health

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Current research in developmental psychopathology has emphasized how emotion dynamics, such as affective variability, affect psychosocial functioning. This study examined affective variability in positive and negative emotions within individuals, compared affective variability between mothers and adolescents, and explored how this variability is linked to each person's depressive symptoms and mother-adolescent relationship quality. We administered individual surveys each day for one week to mother-adolescent dyads (N =109) that inquired about positive and negative affective states. Participants also reported on their depressive symptoms and relationship quality. Affective variability was measured across time in terms of emotional intensity (mean levels) and lability (standard deviations). We used paired samples t-tests for mean differences, correlations to test for variable associations, and linear regressions to predict mental and relational health. Results showed that adolescents' negative affective intensity was significantly higher than mothers' negative affective intensity, but both adolescents and mothers who had more intense and labile negative affective emotions had more depressive symptoms. Greater adolescent positive affect intensity was related to more relationship warmth, whereas greater mother negative affect lability and less mother positive affect intensity was related to more relationship hostility. These findings contribute to the growing body of knowledge on the associations between affective variability and its relation to mental health and relationship quality between mothers and adolescents.

(22)
Racial Disparities in Hearing Loss Diagnosis in Patients with Diabetes

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There are more than 37 million people in the United States who have diabetes according to the American Diabetes Association. Some scientific studies suggest hearing loss could be as much as twice as common in people with diabetes compared to those who don't have diabetes. Within the population that has diabetes, the prevalence of diabetes is significantly higher in African American patients/participants than in White patients/participants. The goal of this project is to assess whether there are racial disparities in the risk of hearing loss in patients with diabetes. To assess potential racial disparities in hearing loss in patients with diabetes, a systematic review was performed using various combinations of the search terms “Race, diabetes, hearing loss, United States, and African American” and the PubMed database. The articles identified in the search were screened and reported according to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA). Articles that included relative risk ratios for hearing loss in African American patients are of specific interest for use in meta-analysis. Racial disparities in hearing loss severity, configuration, and audibility behaviors are being captured and presented in table form, with a Forrest plot used to illustrate meta-analysis results.

(23)
Resources and Access to Gender-Affirming Voice Care across the USA: The Clinician's Perspective

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The discipline of voice therapy has expanded over recent years. This expansion of services is especially growing in the domain of gender-affirming voice care (GAVC) for individuals who wish to communicate and express themselves in ways that are congruent with their gender identity. GAVC

techniques include modifying vocal pitch, inflection, resonance, and speech/language characteristics. Given that GAVC is a relatively new service, it is important to examine various aspects of how clinicians provide GAVC services and how patients/clients can access GAVC. This project explored the status of GAVC from clinicians' perspectives across the United States. We contacted 25 representative Speech-Language Pathologists (SLPs) in the faculty mentor's professional network throughout the U.S. who provide GAVC services. Each clinician was asked to describe resources (e.g., educational, institutional) available to them that have been beneficial in providing GAVC services (Question 1), gaps in resources that could hinder their ability to provide high-quality GAVC services (Question 2), and what they felt was the biggest barrier to GAVC access for their patients/clients (Question 3). Deidentified responses will be recorded and analyzed using descriptive and statistical methods to determine common trends in responses and to observe whether resources and access to GAVC services differ across the country. Outcomes of this study will provide a springboard from which to work to determine how to best improve resources for clinicians who provide GAVC services and begin to address any access issues or barriers to access that patients/clients have to GAVC services (e.g., financial, psychosocial) to improve patients/clients' experiences.

(24)
Role of Glucocorticoids in Stress-induced Migraine-like Behavior in Mice

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Migraine, the second most disabling disease globally, exhibits higher prevalence among women. Stress is a common trigger for migraines that leads to the adaptive release of glucocorticoids from the adrenal cortex, preparing an individual for a threatening event. However, exposure to repetitive stress produces sustained elevations in glucocorticoid levels, which causes maladaptive effects. Therefore, our hypothesis is that glucocorticoids may play an essential role in the mechanism behind stress-induced migraines. We have established a pre-clinical stress-induced migraine mouse model that includes priming to the nitric oxide donor sodium nitroprusside (SNP). We employed repetitive restraint stress to elicit migraine-like behaviors in mice. In this study, we assessed changes in their facial expression through the mouse grimace score and evaluated their mechanical hypersensitivity using the von Frey test. The findings demonstrated that repetitive stress induced mechanical hypersensitivity in both male and female mice. Furthermore, the administration of SNP injections induced mechanical hypersensitivity in previously stressed mice, while control mice did not exhibit such responses. We employed pharmacological manipulation and behavioral tests by utilizing this stress-induced migraine animal model to test the hypothesis. Metyrapone, an inhibitor of glucocorticoid synthesis, was subcutaneously injected before stress to inhibit the production of corticosterone. The data revealed that administration of metyrapone prior to each stress session prevented stress-induced facial mechanical hypersensitivity in both male and female mice. These findings strongly suggest the involvement of glucocorticoids in stress-induced migraine-like behaviors. These results validate our hypothesis and present a potential target for developing innovative therapies for migraines.

(25)
The Availability of Interpreting Services for SLPs and Audiologists Across the U.S.

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The U.S. is culturally and linguistically diverse with over 68 million people speaking a language other than English at home in 2019. Unfortunately, speech-language pathology and audiology professionals do not reflect the linguistic diversity of the U.S. Data from the American Speech-Language Hearing Association show only about 8% of clinicians self-identify as multilingual providers (18,046 out of 217,886). Thus, many speech, language, and hearing (SLH) professionals rely on interpreter services for patient communication. There are many interpreter services to choose from and multiple factors influencing selection. The purpose of this research project is to identify and describe the available options for interpreter services in SLH clinics. The American Translators Association's directory was used to find interpreting services specialized in healthcare. Out of 45 results, 22 were selected for further investigation. To prevent bias, every second company in the results list was further investigated. Information including languages offered, modality, cost and other services were extracted through the companies' website. Any missing information was obtained through phone calls and emails. In addition, the companies were asked if the same interpreter could be used across multiple appointments, and if they offer services in telehealth. If in-person interpretation services were included, they were also asked what parts of the U.S. were able to utilize this service. Of the 22 selected companies, seven were excluded as they did not provide relevant services based on website review.

(26)
Using naturalistic observation and experimental methods to examine parental discussion of weight, bodies, and restrictive eating with their children

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Parents are influential in children's developing body image, with some studies suggesting that parental body comments made during childhood continue to be impactful into adulthood. However, there is little research examining parents' comments related to weight, body shape, and dieting beyond retrospective reports. We have devised two studies to investigate this topic. In study 1, we utilized naturalistic observations of 112 families during their dinnertime in a week-long trial. Coded data included intervals in which mothers or fathers discussed weight, body shape, or dieting were recoded for this study. In addition, intervals that included parental feeding restrictions were recoded for whether restriction was for health, weight, or unspecified. Seven percent of mothers made some kind of weight-related comment, 4% for fathers. Most (79%) weight-related comments were negatively valanced. Only one was directed toward the target child's weight; others were about dieting or older children/adults. For restrictive intervals, 96% were unspecified, 4% were for health, and none for weight. Study 2 is a pilot investigating discussions that will emerge between parents and children aged 3-11 while reading a storybook intended to encourage body positivity. Participants will be video recorded during storybook reading and will engage in discussion questions at the end of both books. Parent comments will be investigated in terms of their target and valence. Current findings suggest that parental overt discussion of weight, body shape, and food restriction might be minimal, and that parents are not engaging in positive body talk, which might have significant, long-lasting impacts.

(27)
The Impact of Sex Differences and Maternal Education on a Child's Language Acquisition

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The development of language abilities in young children can be influenced by sex differences and the educational attainment of their mothers, with female children and children with higher maternal education having better language skills. The current study aims to investigate whether a toddler's sex and maternal education are associated with the development of receptive vocabulary skills. We hypothesize that female toddlers will have better language scores than males and children with higher levels of maternal education will also have better language scores. Using data from the Infant Brain Imaging Study (IBIS), we investigated receptive vocabulary skills using the words understood from the MacArthur-Bates Communicative Inventory – Words and Gestures collected at 12 and 24 months old. Participants included typically developing children with no family history of developmental delays (N =115). Using cross-sectional linear regression models, we separately analyzed the effects of sex differences in toddlers and maternal education on receptive vocabulary skills at 12 and 24 months of age. Our results showed a main effect of maternal education on receptive vocabulary scores at 12 months old [F (2,114) = 3.17, p < .05], where children with high school or some college as their maternal education had better vocabulary scores than children with a graduate degree as their maternal education. No other significant effects were found. Further investigation is necessary to understand the contradictory findings between the results of the current study and previous literature.

(28)

The Lack of Cultural Responsiveness in Online Educational Resources for Parents of Children with Autism Spectrum DisorderThe Lack of Cultural Responsiveness in Online Educational Resources for Parents of Children with Autism Spectrum Disorder

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Families of children with autism spectrum disorder (ASD) require educational resources to facilitate better understanding of and care for their child. Websites and other online guides are a key source of information for many families when it comes to learning about the best parent implemented intervention approaches. When these websites targeted for parents lack cultural responsiveness, they are less beneficial for families from culturally and linguistically diverse backgrounds (CALD). Black and Hispanic American children are a large demographic that are often not considered when creating these resources. The goal of my project is to identify currently available educational materials for parents, evaluate the cultural responsiveness of the available materials, and discuss how the identified materials can be changed, to be more culturally responsive. To accomplish this, a Google search was performed for the queries "what is autism?", "how to parent a child with autism?", and "what are signs of autism in children?" and the top 5 reoccurring results were visited and evaluated. The Multiculturally Competent Service System Assessment Guide was used to assess these resources to determine their cultural responsiveness. In addition, the cultural responsiveness of the five selected websites was contrasted with the cultural responsiveness of websites that are specifically targeted towards African American or Hispanic American families, such as The Color of Autism Foundation to test the hypothesis that broad-audience materials will be rated lower on cultural responsiveness than websites specifically targeting diverse patient populations.

(29)

Utilizing a modified interatomic potential for molecular dynamics methods to observe changes in the atomic structure of cathode materials undergoing strain

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Due to the growing demand for clean energy storage, Li-ion batteries (LIB) have been under worldwide study during the past two decades. Current interatomic potential methods for LIB cathode materials normally use fixed charge models, which cannot model the dynamical oxidation state change of transition metals during electrochemical reactions.
Developed to model large scale atomic simulations, Charge-Transfer Modified Embedded-Atom Method (CT-MEAM) provides potentials that can create optimized simulated structures of cathode materials under uniaxial, biaxial, and hydrostatic strain. Here, I apply strain to LMNO/LMCO structures to provide further insight as to how strain impacts the atomic structure of LMNO and LMCO, resulting in the improved design of Li-ion cathode materials. Strain causes most cathode materials to become inefficient; simulating the process of applying strain provides a better idea of how strain changes their structure and can be prevented.
CT-MEAM potentials reflect changes in the cathode material's oxidation state caused by lithiation through the charge transfer interatomic potential (CTIP), which studies atomic charge transfer within metal oxides. The advanced MEAM potential can also reproduce both the covalent and metallic bonding present within cathode materials, contributing to CT-MEAM's reliability as a method for high-energy density LIB simulations.
This simulation will be executed via a classical molecular dynamics code with a focus on materials modeling: Large-scale Atomic Molecular Massively Parallel Simulator (LAMMPS). This method allows for a better understanding of how strain impacts a LIB cathode material, as well as demonstrating that CT-MEAM is a suitable dynamic charge model for large-scale atomic simulations.

(30)
Poly (3-hexylthiophene) Based Semiconductors

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Traditional semiconducting materials are composed of silicon lattices. Alternative materials may have superior properties to silicon. These properties could entail the productive substitution of non-silicon materials for unique applications. One such class of material is organic polymers. Polymer-based semiconductors may have a comparative advantage when used in solar cells, sensors, or transistors. For polymer-based semiconductors to be more deeply considered, their properties should be better understood. This research project focuses on the material poly (3-hexylthiophene), or P3HT. As the ratio of a P3HT chip's dimensions changes, there may be a noticeable difference in its charge mobility.
Polymers have a characteristic structure made up of repeating monomer units. The monomer units form carbon-bonded chains that arrange in a crystalline structure. Poly (3-hexylthiophene) may transport charge within these bonded chains and between independent chains.
A semiconductor parameter analyzer can quantify a material's electrical properties. This instrument uses probes to gather data. For this research, a set voltage of around 100 V is necessary. Ordinarily, the parameter analyzer does not exceed about 30 V. The instrument's software does not allow high voltages without toggling a safety interlock switch.
For further investigation into the charge mobility of P3HT chips, the semiconductor parameter analyzer must be allowed to reach higher voltages. Diagnosing the machinery, including the interlock switch, safety fixture, and interlock cable, is necessary. New parts may also be required.

(31)
Non-volatile Memory Circuit with Self-Terminating Read Current

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This research investigates the implementation of a “Non-volatile Memory Circuit with Self-Terminating Read Current” (name of the paper I was assigned). The proposed circuit combines the advantages of SRAM and FPGAs. It offers non-volatility, allowing for "instant on" applications where data can be readily accessed during startup without needing external data retrieval. Additionally, the circuit is compatible with existing CMOS technology and can be compared to FPGAs.
The circuit was designed and developed before I began working on the paper, my job was to run simulations using Virtuoso to collect data. The functionality of the cell was validated through SPICE simulations conducted on the Global Foundries 12 nm process. Once the desired results were achieved on a single-bit cell a 2x2 array of the circuit was created to evaluate its read and write capabilities. The array setup yielded the expected outcomes, and the gathered data was compiled and presented using graphs to help others understand.
This research offers promising insights into the development of a Non-volatile Memory Circuit with Self-Terminating Read Current, bridging the gap between SRAM and FPGAs. The circuit's non-volatile nature, compatibility with current CMOS technology, and ability to provide instantaneous data access during startup make it an appealing solution for various applications even security. The results of this research will help advance memory circuit design and hopefully pave the way for further exploration in this field.

(32)

Theoretical Estimation of the Effect of Grain Size of Polycrystalline Diamond Films on Bio-Functionalization of E. Coli K12 Antibodies Linking to SurfaceTheoretical Estimation of the Effect of Grain Size of Polycrystalline Diamond Films on Bio-Functionalization of E. Coli K12 Antibodies Linking to Surface

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Ultrananocrystalline diamond (UNCD) film is known for its remarkable tribological properties, biocompatibility, chemical inertness, and thermal stability. UNCD films’ surface chemistry provides exceptional linking to functional organic molecules, enabling the development of new biosensors. Prior research by Auciello’s group demonstrated the feasibility of immobilizing E. coli K-12 antibodies’ molecules on UNCD surfaces, demonstrating this biofunctionalization process. However, there is a gap in research regarding the relationship between grain size and the number of immobilized antibodies on UNCD surfaces. The research described here focused on estimating the number of antibodies on UNCD films’ surfaces based on average grain size and the percentage of grain boundaries for UNCD and microcrystalline diamond (MCD) films.
UNCD and MCD films were grown by Hot Filament Chemical Vapor Deposition (HFCVD) on SiO2 (1 µm thick layer)/Si substrate. Gas flows with varying proportions of hydrogen, methane, and argon were utilized. Raman spectroscopy was employed to confirm the UNCD film structure. X-Ray Diffraction (XRD) analysis was performed to determine the films’ grain sizes. The Full Width Half Maximum values of the XRD diamond peaks were measured to estimate the grain size using the Scherrer equation. The ChimeraX software enables estimation of IgG antibody molecule’s dimensions with ellipse shape, thus enabling estimation of the number of antibodies immobilized on various UNCD film-covered areas. The calculations’ results indicated a range of antibody numbers from 10^6 to nearly 10^8, providing valuable information on the potential quantity of antibodies that can occupy UNCD-covered surfaces, which is critical for the design of biosensors.

(33)

Effect of X-ray irradiation on a-IGZO and ZnO thin-film transistors for radiography applicationsEffect of X-ray irradiation on a-IGZO and ZnO thin-film transistors for radiography applications

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In recent years, Zinc Oxide based (ZnO) or Indium-Gallium Zinc Oxide (IGZO)- based thin film transistors have been widely studied due to reduced thermal budget compared to silicon-based thin film transistors. In addition, silicon-based devices degrade significantly in harsh environments such as high energetic photon irradiation (x-rays, gamma rays), whereas ZnO and IGZO-based TFTs are potential alternatives that have not been thoroughly explored under such conditions. Understanding how IGZO and ZnO TFTs can tolerate harsh conditions and how they degrade is crucial. We are performing a comprehensive and comparative study of IGZO and ZnO TFTs and the effects of radiation. The TFTs were exposed to X-ray radiation with varying doses from 1 gray to 1000 gray and evaluated their performance before and after irradiation. This study allows us to assess the degradation of the main TFT parameters, such as saturation mobility, voltage threshold, subthreshold swing, and (ION/IOFF) ratio. The preliminary results show reduced TFT threshold voltage in IGZO with increasing X-ray dose without minimal impact on subthreshold slope and electron mobility. On the contrary, ZnO shows a reduction of the VTH and electron mobility with an increase in the subthreshold slope. To fully understand the effect of the radiation on the TFTs, we will evaluate the structural and chemical properties of the metal-oxide-semiconductor layers before and after X-ray irradiation.

(34)
Minimizing the fine line width of ion milling using FEI Nova200FIBMinimizing the fine line width of ion milling using FEI Nova200FIB

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Ion milling is an integral feature of a focused ion beam (FIB) for modifying the surface of a specimen. Various structures, such as holes, shapes, images, and other surface distinctions, can be produced using this technology. The Nova200FIB is capable of small, high-resolution milling at 7nm at 30 kV via a Gallium liquid ion source. We tested the precision of the ion milling by writing a name via Bitmap imaging. The most critical factors to minimize fine line width were probe current, pattern box size, and magnification. The ideal ion beam current is ten pA at 30 kV. The pattern ratio for the x-value and y-value is 3:1, and the z-value is 1. The optimal magnification on the ion beam is 12,000x. These settings led to the result of an eligible written name in which the finest line was approximately 45.8nm.

(35)
GaN and BA in semiconductorsGaN and BA in semiconductors

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This research investigates the fusion of Gallium Nitride (GaN) and Boron Arsenide (BA) in semiconductors to enhance heat conduction while maintaining electron flow integrity. In high-power electronic devices, efficient heat dissipation is crucial to prevent performance degradation and ensure reliability. GaN is renowned for its exceptional electron mobility and power handling capabilities, while

BA possesses remarkable thermal conductivity. By combining these materials, it is possible to achieve enhanced heat conduction without disrupting the flow of electrons. Experimental studies have shown that GaN-BA composites can significantly improve thermal conductivity without compromising the electrical properties of the semiconductor. This innovative approach offers a promising solution to address the thermal challenges encountered in high-power electronic devices. The fusion of GaN and BA holds great potential for improving heat conduction in high-power semiconductor devices, thereby enabling enhanced thermal management and overall performance. The compatibility of the crystal structures and lattice constants of GaN and BA allows for their integration through various fabrication techniques such as molecular beam epitaxy or metalorganic chemical vapor deposition. The experimental findings support the notion that GaN-BA composites can be optimized to strike a balance between efficient heat conduction and the preservation of electron flow. This research contributes to advancing the understanding of how GaN and BA can be synergistically combined to overcome thermal limitations in semiconductor devices.

(36)

Electrical Characterization of Ferroelectric-based Capacitors with Applications to Analog Capacitance Memory Devices.Electrical Characterization of Ferroelectric-based Capacitors with Applications to Analog Capacitance Memory Devices.

Marino Santos
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Ferroelectric materials have emerged as viable alternative to typical insulators in the field of semiconductor memory, offering unique properties that enable efficient storage and retrieval of analog information. Ferroelectric capacitors exhibit a hysteresis behavior in their polarization-voltage (P-V) characteristics, enabling the storage of multiple states corresponding to different polarizations. Analog memcapacitor devices vary the capacitance of ferroelectric capacitors to store and manipulate analog information. By exploiting the ability of ferroelectric capacitors to retain charge even after the applied voltage is removed, analog capacitance memory systems can store and update continuous voltage levels, enabling the next generation of memory technologies. The electrical characterization of the three 75 μm ferroelectric capacitors is measured through extensive tests comprising of polarization-voltage (P-V) characteristics, current density-voltage (J-V) characteristics, capacitance-voltage (C-V) characteristics, and pulse read write test. The memory reliability of the device is deduced by linear nature of the retention and access time graph can be used predict the future capacitance values. From the linear extrapolation of the retention and access time data, the capacitance of the device at a retention and access time of 10^8 seconds ≈ 3 years is calculated which infers that the device possesses a steady capacitance and a high endurance. These properties of non-volatility, high endurance, and fast switching capabilities make them ideal candidates for ferroelectric-based analog capacitance memory devices.

(37)

How Does Adult and Child Language Use During Mealtimes Impact Children's Language Outcomes in Spanish-speaking Homes?

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A child's language environment has a significant impact on their language outcomes (Hart & Risley, 1995). Most studies in this area look at child-parent interactions, potentially missing other critical language input in the home. In this study, we used a more wholistic measure by considering the total language environment of a child by including language input from all adults in the home (e.g., parents,

aunts, etc.) to address how adult and child language use during mealtimes impact children's language outcomes in Spanish-speaking homes. To do this, we analyzed mealtime transcriptions of 17 children between the ages 3-6 years. Each utterance was categorized as a declarative, imperative, or question. These utterance types were compared to the child's language abilities, as measured by the QUILS:ES. Consistent with our hypothesis, adults asking closed-ended questions was negatively correlated to language outcomes (Levine et al, 2020). When controlling for two factors known to influence child language abilities- age (in months) and overall conversational turns- adults using closed ended questions at mealtimes (e.g., "did you drink your milk?") was negatively correlated to overall processing abilities ($r(13)= -.568$, $p= .027$). Interestingly, adults asking open-ended questions was not correlated to better language outcomes. We note the small sample size was a limiting factor in this study. Given that mealtimes are stressful for both parents and children, the results shed light on the types of conversations that adults should try to avoid, to lessen the detrimental factors that will impact children's language abilities.

(38)
Language and Prosodic Performance in Spanish-English SpeakersLanguage and Prosodic Performance in Spanish-English Speakers

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Introduction. Statistical learning involves implicit learning of rules; these are important for learning language. Adults rely on statistical regularities to learn syllable and prosodic sequences (i.e., placing different stress on syllables). While substantial work on statistical learning and prosodic variation exists, culturally responsive research is needed to explore underrepresented groups, such as Spanish-English bilingual speakers. In the present study, we asked: How do Spanish-English speaking adults with either high or low English proficiency apply prosodic structure in a statistical learning task? We hypothesized that adults with high English proficiency would apply prosodic variation to patterned syllable sequences.

Method. Four adults, drawn from the total 31 participants, were included in the current study. A case history was used to determine language exposure in both first and second languages. Participants were divided into high and low language proficiency groups based on their performance on a set of language measures. The experiment involved spoken repetition of nonwords; half of the words followed a pattern, and half did not. All nonwords were free of prosodic variation. Acoustic metrics, including amplitude and duration, were measured using Praat software to determine if participants imposed prosodic variation on the patterned syllable sequences.

Anticipated Results. We are in the process of analyzing two of the four patterned words: /mɪ.pɛ.dɪ.pʌ/ and /pæ.bɛ.fʌ.mæ/. We predict that high, but not low, proficiency adults will show enhanced sensitivity to prosodic sequences over the course of learning, as indicated by their application of prosodic variation.

(39)
Effects of Latine Parent Calm Authority on Language of Autistic Children

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Reciprocal communication with caregivers is essential for developing children's language and social communication. Caregiver-child interactions in Latine families center on the value of respeto. Respeto

involves caregivers calmly and affectionately asserting their authority while conveying expectations that facilitate affiliative and obedient responses from their children. The aim of this study was to evaluate whether Latine caregivers' calm authority influenced their autistic children's language. Twenty-six Latine caregivers and their autistic children were video recorded during naturalistic play sessions. Interactions were transcribed and coded for Parent Calm Authority (PCA), number of different words (NDW), which measures vocabulary, and Mean Length of Utterance in words (MLU), which measures language complexity. Results revealed that PCA did not correlate with concurrent child language measures. Furthermore, with the exception of Child Affiliative Obedience (CAO), none of the family background or child variables related to PCA. We suggest that a parent's PCA is so deeply engrained as a result of their cultural upbringing that it remains unaffected by factors such as their socioeconomic status, level of education, their child's social or linguistic abilities, or even the level of their child's autism symptomatology. These findings show that the confidence and calmness of the caregiver's authority do not relate to the concurrent language ability of their autistic child; rather, they emphasize the clear dyadic relationship between PCA and CAO.

(40)
Relating Coordinated Sequential Motor Tasks to Novel Sign Production in Children with Developmental Language Disorder

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Developmental language disorder (DLD) is classically an impairment in the understanding and use of language. Children with DLD struggle with sequentially patterned elements that structure language, including sign language. Deficits are also observed within the motor domain, specifically in manual dexterity and balance. Our goal was to evaluate the relationship between motor skill and novel sign production, with a focus on complex coordinated sequences. Finding connections among these motor and sign language skills would clarify the motor factors that underlie DLD and have implications for the assessment of these children. We analyzed fine and gross motor skill as indexed by the Movement Assessment Battery for Children-Second Edition (MABC-2), as well as the path phonological accuracy and hand movement stability of novel sign production in young children with DLD and their typical peers. We predicted and found that the DLD group was weak in both motor and linguistic skill as indicated by group differences in manual dexterity, balance, path accuracy, and hand movement stability. Additionally, we found that, while impaired in DLD, hand movement stability and manual dexterity are not related. Finally, we predicted that specific tasks in the MABC-2 would relate to either path accuracy or movement stability of novel signs that required coordination and sequential patterning. Evidence in support of this hypothesis was mixed. Our findings indicate that balance may be related to both phonological accuracy and movement stability of sign in both groups. Future work should use more targeted and nuanced measures to draw any specific conclusions.

(41)
Importance of Latine Parent Language and Responsivity in Eliciting Obedience from Autistic Children

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Interactions between Latine parents and their children are guided by respeto, a cultural value that involves calm authority from the parent and affiliative obedience from the child. Previous studies indicate that child affiliative obedience (CAO) positively correlates with parental sensitivity and the amount of language spoken by the parent. However, autistic children, who often exhibit language and social communication difficulties, may benefit from parental language input that is more finely tuned to their own linguistic abilities rather than from increased language input. Thus, this study examines how

parent-child language match and sensitivity within parental responses shape the CAO of Latine autistic children. Twenty-six Latine autistic children and their parents were video recorded during naturalistic play sessions. Child communication and temporally contingent parent responses were transcribed and coded for the child's mean length of utterance in words (MLUw), the parent's MLUw, parent responsivity type (i.e., responsive, directive, or no response), and CAO. The difference between the parent's and the child's MLUw was computed to measure the degree to which a parent's verbal responses matched their child's language. After adjusting for the child's nonverbal intelligence scores, results revealed a strong and significant positive relationship between CAO and parent-child MLUw match. However, CAO levels were not significantly correlated with any one type of parent responsivity. These findings support the notion that Latine parents can play an active role in the enculturation of their autistic children by matching their language to their child's linguistic level.

(42)
The Role of Household Chaos in the Link between Socioeconomic Status and Sleep Quality of Hispanic/Latino Parents

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Higher socioeconomic status (SES) is consistently associated with better sleep. One family mechanism that could explain this association is household chaos, which is characterized by a disorganized or confusing environment within the family home. A period in which household chaos may be particularly high is during early childhood. Thus, the goal of this project is to determine if household chaos explains the association between SES and sleep in Hispanic/Latino parents of young children aged 1-5. To address this goal, we used a 10-day daily diary methodology where primary caregivers of children aged 1-5 years (N=43) reported their daily perception of household chaos every night. In the morning, participants reported their sleep quality, duration, and continuity from the prior night. To determine SES, participants reported their household income, employment, and highest level of educational attainment. We hypothesize that caregivers with lower socioeconomic status will report greater levels of household chaos and subsequently report poorer sleep quality. To test these hypotheses, we will average household chaos and sleep across the 10-day period. Then, we will use PROCESS to test the mediational pathways. Understanding the role of household chaos on the sleep quality among Hispanic/Latino parents is critical, as it may shed light on the development of targeted, culturally sensitive interventions aimed at reducing health disparities and promoting equitable health outcomes including better sleep. By examining this complex interplay, this study has the potential to uncover underlying mechanisms contributing to health disparities within this specific population.

(43)
Association between Adult Attachment of Parents and Child Sleep in Hispanic/Latino familiesAssociation between Adult Attachment of Parents and Child Sleep in Hispanic/Latino families

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How parents feel in their romantic relationship may affect child outcomes. Parents high in attachment avoidance are not comfortable with closeness or relying on their partners, while parents high in attachment anxiety worry about being abandoned or unloved by their partners. These relationship beliefs may affect child outcomes, including sleep, via parenting. To our knowledge, no research has examined the relationship between adult attachment and child sleep in Hispanic/Latino families. Thus, the goal of this study is to examine the association between the adult attachment of parents and child

sleep in Hispanic/Latino families and determine if parenting may explain this association. To address this goal, Hispanic/Latino parents (primary caregivers; N = 43) of children aged 1-5 years completed a self-report assessment of adult attachment, parenting behavior (hostile/coercive vs supportive/engaged parenting), and their child's sleep. Based on previous studies, we predict that more securely attached parents (low avoidance and low anxiety) will report fewer child sleep problems than parents high in avoidance or high in anxiety and more positive parenting behavior will explain these associations. Although data analyses are currently underway, preliminary results suggest that parental attachment anxiety and avoidance are not related to parenting. If parental attachment is related to child sleep, these preliminary results suggest that parenting may not be a potential explanatory mechanism in Hispanic/Latino families. This finding will need to be replicated in larger samples.

(44)
The Impact of Siblings' Language and School Language Use on Spanish-Speaking Children's Dual Language Development

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Spanish is the second most spoken language in the US, yet Spanish use at home has declined in recent years. There's abundant research on how parents influence language development, with some related to bilingual development, but there's little work on how other aspects of early life, like interactions with siblings and in schools, which often include English interactions, impact children's dual language development. This study aims to identify the degree to which siblings' language use in the household and school impacts the language development of Spanish English bilingual 3–5-year-olds. To answer this question, we studied the relationship between children's Spanish and English language abilities (as measured by the QUILS:ES) and how much English or Spanish children heard (1) when interacting with siblings and (2) in their school (both based on parent report). The results revealed a significant positive correlation between English language use in school and English language abilities. We found no significant relationship between Spanish language skills and Spanish language use in school or with siblings. This indicates that while parent language use is still the strongest predictor of Spanish language development, the school language environment plays a critical role in children's second language development.

(45)
The Association Between Parental Sleep and Parent Child Interactions: The Role of StressThe Association Between Parental Sleep and Parent Child Interactions: The Role of Stress

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Parental sleep likely plays a role in parent-child interactions. Research shows that poor sleep is associated with greater reports of stressful experiences. Therefore, poor sleep may interfere with parent-child interactions due to increases in everyday stressors. The goal of this study is to determine how sleep relates to perceptions of everyday stressors and how these relate to parent-child relationships. To accomplish this goal, parents (primary caregivers; N= 43) who identify as Hispanic or Latino and have children between the ages of 1 to 5, completed a 10-day daily diary study in which they reported on their daily stressors, parent-child interactions, and sleep. Each night, parents rated the degree to which they interacted with their child in positive and negative ways and indicated if they experienced stressors within 7 different categories. Each morning, parents reported their sleep duration, sleep quality, and sleep efficacy- the continuity of their sleep. We hypothesize that after

nights of shorter sleep duration, poorer sleep quality, or less sleep efficiency, parents will experience more daily stressors and thus report more negative (and less positive) interactions with their children. To test this hypothesis, the daily data was aggregated across the 10- days to create composites of parental sleep, stressors, and parent-child interactions. Statistical mediation analyses are being conducted with PROCESS. Although data analysis is still underway, we hope the potential results highlight the need to consider parental sleep in child development, as positive parent-child interactions are critical for healthy child development.

(46)
Relations Among Parenting Quality in Ethnic-Racial Socialization and Child Ethnic Identity in Black and Latinx YouthRelations Among Parenting Quality in Ethnic-Racial Socialization and Child Ethnic Identity in Black and Latinx Youth

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Ethnic-racial socialization is a fundamental process in identity formation in which children adopt values and beliefs about their ethnic group from their caretakers. Promoting a strong connection to the child's cultural background can result in better academic, behavioral, and emotional outcomes for children of color. Our research observed if parenting strategies measured in discussions about racism between parent and child have an impact on child ethnic identity. 81 Black and Latinx families and their children were assessed at home during a racial socialization observation task (RSOT) involving hypothetical scenarios of ethnic discrimination between a school counselor and student. Raters reviewed video recordings of the interactions to objectively measure parenting qualities like warmth, cultural pride, critical consciousness raising, addressing issues of physical safety, among others. Children were also assessed for child agency and externalizing factors, among others. Child ethnic identity was self-reported using the Multigroup Ethnic Identity Measure (MEIM). Significant interactions between RSOT measures and ethnic identity varied across child ethnic groups and gender. These findings indicate relationships between parenting strategies and child identity in the school environment. This is especially important in the face of potential racial bias and serves to safeguard a child's social-emotional wellbeing in school and tells us more about how parents prepare their children for such circumstances.

(47)
Using OpenFAST to Create a Database of Offshore Wind Turbine Fatigue Loads

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The rotor size of a wind turbine is directly proportional to its power production capabilities. Wind energy is moving offshore, where these larger turbines have more space and constant winds. However, operating wind turbines in this new scale and environment requires designers to consider the unique, large structural loads that come with it. The wind turbine design process requires simulations of the Design Load Cases (DLCs), combinations of environmental and operation conditions wind turbines must be prepared for. While wind turbine models are run through simulations of extreme and normal conditions, there is no complete life-cycle analysis of offshore wind turbine (OWT) loads, quantifying the fatigue loading accumulation from wind and waves. The aim of this project is to perform a comprehensive loads analysis of OWTs to characterize and quantify the impacts of various wind and wave conditions at major turbine components (blades, tower, foundation, etc). I studied safety and engineering requirements, modern OWT designs, and OpenFAST operation to prepare for this. OpenFAST (Fatigue Aerodynamics Structures and Turbulence) is a fully coupled wind turbine simulation program designed by the National Renewable Energy Lab. By running

OpenFAST simulations for DLC 1.2 (Steady state condition), I will accumulate the simulation data to build a long-term database of the fatigue life effects of wind and wave loads on OWTs. The detailed fatigue database would benefit the wind energy research and development community by providing the information required to better understand life-cycle loads, validate loads models, and plan offshore wind turbine operations.

(48)
Thermomechanical Modeling Framework for the Additive Manufacturing of SS 316L

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Additive manufacturing (AM) can produce three dimensional objects by depositing material by a single, detailed layer at a time. Despite this technology creating complex geometry during the manufacturing process with reduced waste, AM is also known to generate significant amounts of residual stress (RS) within manufactured parts. Due to large, localized thermal gradients, RS can cause cracks and distortion, rendering parts useless. Computational models and simulations that effectively demonstrate the deposition process during AM can supply significant insight into improving or preventing the detrimental effects of residual stress. Using finite element (FE) models is common, as they can predict mechanical behavior like stress-strain or other structural responses. Current research has created an integrated modeling framework that exploits the individual benefits of thermomechanical and thermofluidic prediction techniques while avoiding their respective limitations to offer valuable combined predictive capability for AM. The work herein describes an effective framework for modeling the cool down of a build-substrate region made of stainless steel 316L during AM. The presented model demonstrates a directed energy deposition (DED) process, and is stimulated to validate the predicted geometry and RS profile. A single-layer stainless steel 316L build is primarily considered. Collating results between the thermomechanical model and measurements from a previously published work divulge that the described FE framework is effective at representing the thermomechanical behavior of the DED process. The methodology presented can be expanded to research other metal AM processes, including solid feed processes such as additive friction stir deposition.

(49)
Wind Turbine: Requirement Database Development

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The purpose of this project is to create a large dataset of requirements to be used in the future to study relationships between requirements of a complex system, such as wind turbines. A requirement is a criterion or constraint statement that includes a subject, verb, modality, object and adjuncts. They describe engineering problems and determine the criticality of solutions. Requirements come from different sources such as codes and standards, people who are affected by and contributed to generating a complex system. The dataset will be used to analyze source considerations and outline what considerations could be made. A literature review of journal articles, books, websites, technical reports were used to generate the database. This was supplemented with three interviews, two with faculty members Dr. Hongbing and Dr. Qian and the other with wind energy researcher Kenny Nonso-Anyakwo to note what they considered to be important requirements in their area of research on a wind turbine. Finally, requirements were extracted from guest seminars of the Research Experience for Undergraduates (REU). The requirements from these sources were obtained by note taking. The data was confirmed by which ones repeated and noted where they opposed each other. The volume of requirements for a Senior Design project being undertaken for one semester may be

about fifteen. However, this requirement database of a complex system contains two hundred and eighty-two coded against these columns: Serial No., Unit/Symbol, Modality, Predicate, Conditions, Integrated Requirement, Criticality, Object of Action, Functional vs Non-Functional, Source, Source Type, Feasibility, Justification and Date.

(50)
Optimal Design and Operation of District Heating System with Wind Power and Grid Connection

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Renewable energy sources have been increasingly penetrating the US energy market as initiatives such as Wind-to-X push for the direct use of renewable electricity for end use cases across all sectors to achieve net-zero emissions. Concurrently, building electrification, e.g., heat pump driven space conditioning and water heating, has emerged as a promising pathway for decarbonization and resilience by displacing the consumption of fossil fuels and better utilization of local/on-site renewable power generation and energy storage. In this project, a multi-disciplinary optimal design framework for a grid-interactive heat pump driven district heating (DH) system with wind power generation and thermal energy storage (TES) is proposed, with Lubbock County, Texas as the location for the illustrative case study. The energy economy of this community DH system is evaluated based on the historical data of wind, heating load temperature, and dynamic electricity price for this area, from national and regional databases. Wind power modelling, thermal load modelling, TES unit modelling, stochastic optimization for the minimization of seasonal energy cost, and sizing optimization of TES and wind power capacity is performed to maximize the economic viability. The benefits to the cost-effective development of carbon neutral communities and the grid-interaction oriented synergy between renewable power generation and building electrification are also exemplified. The proposed method is applicable to all areas nationwide that demand for heating related energy resilience so that the energy fragility demonstrated in the 2021 Texas power crisis can be avoided. The framework can be extended to district cooling as well.

(51)
Modeling and Control of an Experimental Scaled Wind Turbine

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Wind energy is a vital tool in our reduction of carbon emissions, and the world's installed wind capacity will continue to increase over the coming decades. A fraction of this power will come from large (and getting larger each year) wind turbines, which use various control strategies to maximize the amount of power each turbine captures. Better control strategies require a deeper understanding of turbine dynamics making this a prime area of research, including the use of scaled turbines evaluated in wind tunnels. The G06 is one such turbine, equipped with the three mechanisms commonly used for turbine control: the direction the turbine is facing (yaw control), the angle of attack of the turbine blades (pitch control), and the amount of power extracted from rotation and turned into electricity (torque control). Computer models of turbines allow faster testing and tuning of control systems where this process would be expensive or dangerous otherwise. We were able to create a digital twin of the G06 and compare its predictions against data collected using the BLAST wind tunnel. The data consisted of wind velocity measurements from an upstream pitot tube, rotor position and rotation speed measurements from an optical encoder built into the G06, and torque reading also from the G06. The accuracy of the digital twin was estimated from wind tunnel measurements.

(52)
Techno-Economic Analysis of Hybrid Offshore Wind and Hydrogen Systems in Northeastern U.S.

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The northeastern coast of the United States features significant potential of offshore wind farms, and in order to meet the current government targets for thirty gigawatts of offshore wind energy by 2030, more research is needed into techno-economic feasibility. A primary focus of this study is to compare the economic viability of different configurations of offshore wind farms with energy storage. Power-to-X technologies, specifically offshore wind to hydrogen, are evaluated to assess the feasibility of the hybrid energy system. The System Advisor Model (SAM) developed by the National Renewable Energy Laboratory has been adopted to perform the techno-economic analysis. The investigation of the hybrid offshore wind and hydrogen system is desired for the future of offshore wind, as current costs are dependent on government incentives that are short term.

(53)
Increasing the Lifespan of a Wind Turbine Gearbox

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A great number of wind turbine gearboxes experience premature failure. The objective of this research project is to understand why this happens and propose a solution to increase the durability of the turbines and consequently lower the cost of energy. Analyzing Large Eddy Simulation (LES) results of ideal and real wind farms, we have found that wind shear, tower shadowing and the terrain cause torque fluctuations and dynamic loads shortening the life of the gear box. Probability Density Function and fast Fourier transform were calculated to obtain the main frequencies of the torque fluctuations. We found that complex topography and incoming wind turbulence influence the dynamic loads experienced by the turbines. Currently gearboxes are designed for ideal wind conditions. While it would not be economically feasible designing a gear box for the particular wind condition each turbine is experiencing, it was found that adding a pair of non-circular gears and a flywheel to the gearbox reduces significantly the load fluctuations and has the potential to extend the life of the turbine. Noncircular gears can be used to retrofit existing turbines as well as in new designs.

(54)
VARIM process monitoring utilizing Radio Frequency Moisture Sensors and Thermocouples
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The Vacuum-assisted Resin Infusion Molding (VARIM) process is widely utilized in the manufacturing industry, particularly for wind turbine blades. However, improper control of the process can lead to uneven curing and defects that reduce the life span of the blade. While optimization of this process is possible with physics-based simulations, the time required for these simulations prevents real-time adjustments. To overcome this limitation, Machine Learning (ML) can be employed alongside the data from the physics-based simulations to create a ML-based model capable of performing computations in seconds. Previous work at UTD resulted a ML-model that can predict the temperature distribution in the composite based on the VARIM processing parameters of heating and

number of plies. The end goal is to develop a closed-loop feedback system, where the ML model informs the parameters adjustment based on the prediction results, making real-time adjustments possible for blade manufacturing. Initially, the project starts with composites consisting of 3 plies to analyze the curing process and develop a closed-loop feedback system. Subsequently, the complexity will be increased to match the real-world application by experimenting on a sandwich structure. During the curing process, the degree of cure will increase, and the temperature of the resin will decrease. The degree of cure and temperature will be quantified through the use of Radio Frequency Moisture Sensors and Thermocouples. The collected data will be employed to train and validate the ML model.

(55)

A Deep Learning Approach to Predict Boundary Conditions During the Vacuum Assisted Resin Infusion ProcessA Deep Learning Approach to Predict Boundary Conditions During the Vacuum Assisted Resin Infusion Process

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Vacuum Assisted Resin Infusion Molding (VARIM) is a commonly used process in wind turbine blade manufacturing, where temperature plays a crucial role. However, the existing physics-based models suffer from long computation times, making them impractical for process optimization. In this project, we propose a data-driven approach using machine learning to predict temperature and substance boundary conditions during VARIM. Our approach utilizes convolutional neural networks (CNN) to analyze the deep features of input images and predict the corresponding heating conditions at the boundary as well as the permeability of the substance. Two separate CNN models were developed to handle different datasets with varying boundary conditions. The performance of the models was evaluated based on their ability to accurately predict the boundary conditions, measured by low mean absolute percentage error (MAPE) and accuracy. The results demonstrate the effectiveness of the CNN models in predicting boundary conditions with high accuracy, with most recent evaluations receiving a 1.75 % error, and highlights the potential of machine learning in improving process optimization for VARIM. Future developments in this project will incorporate datasets with deformations to enhance optimization capabilities and leverage the predicted boundary conditions to estimate temperature gradients during the VARIM process.

(56)

Study of leading-edge protuberances on aerodynamic performances and load mitigationStudy of leading-edge protuberances on aerodynamic performances and load mitigation

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In recent years, protuberances on the leading edge of wind turbine blades have gained popularity. First observed in marine animals such as the humpback whale. With the largest flipper length of any cetacean, fluid drag is something the humpback whale must overcome. It is theorized that the rounded protuberances aid the whale's hydrodynamic performance and improve the whale's ability to turn. The whale's flipper and turbine blade can be characterized as basic airfoils. An effective airfoil produces lift while minimizing drag, additionally, an effective airfoil postpones the boundary layer separation therefore reducing recirculation and energy loss. To improve wind turbine control methods for performance, there are passive and active options. Passive options are favored because they require less complexity and maintenance, mechanically, than active. With the humpback whale flipper as a catalyst for passive control, researchers have begun studying the effects of protuberances on wind turbines. Researchers have studied multiple parameters to examine how each condition affects

performance with respect to changes in parameters. The goal of this project is to study the aerodynamic performance, such as lift and drag coefficients, these protuberances produce. The protuberances are modeled on a NACA 4412 airfoil as sinusoidal waves and span half the span length of the airfoils, similar to the humpback whale flipper. Three modified airfoils with different sinusoidal patterns are tested against an unmodified airfoil.

(57)
Analyzing the Effect of Left Vagus Nerve Stimulation on Food Consumption

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The vagus nerve plays a crucial role in monitoring stimuli in the gastrointestinal (GI) tract and transmitting signals to the brain, thereby maintaining homeostatic control of food intake. Here, we aim to explore the effects of vagus nerve stimulation (VNS), which has been FDA approved for the treatment of major depressive disorders and stroke rehabilitation, on food-seeking behavior and weight regulation. In this study, adult male rats (n = 5) were implanted with stimulating cuff electrodes around the left cervical vagus nerve. After surgical recovery, rats received VNS or sham stimulation for 30 minutes in their home cages, followed by a 30-minute session in which subjects could nose-poke to receive a food pellet. VNS or sham stimulation continued during the nose-poke session. Pellet consumption was monitored during the nose-poke sessions and chow consumption in the home cage was also recorded daily. Based on prior studies, we hypothesized that VNS would reduce food consumption during and following stimulation. We observed food intake increased during stimulation sessions, however, chow intake slightly declined between stimulation sessions when compared to the sham period. This work is expected to shed light on the vagal mechanisms that contribute to feeding behavior, potentially informing the development of VNS strategies for obesity.

(58)
Assessing the Impact of Early Life Sensory Overstimulation on Later Life Behavioral Function in Rodents

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The average age at which children begin to watch TV continues to decline. Yet, there is little research regarding the extent to which excessive sensory overstimulation in infancy affects cognitive and behavioral function during later life. Knowledge regarding the long-term impact of early life sensory overstimulation is crucial for understanding how it may increase risk for neuropsychiatric disease via disruption of behavioral processes such as risk-taking, anxiety-like behavior, memory and cognition, among others. To this end, we adapted a rodent model mimicking sensory overstimulation by subjecting developing rats to daily audio and visual overstimulation from postnatal days 10-40 and conducted behavioral tests to measure anxiety-like behavior, risk-taking, cognitive function, social behavior, compulsive behavior and spatial learning. Male and female animals underwent a behavioral test battery including: Elevated Zero Maze, Open Field, Novel Object Recognition, Social Approach, Marble Burying, and T-Maze during late adolescence/early adulthood. Previous studies in rats suggest that overstimulated rodents exhibit increased locomotor activity and risk-taking and impaired short-term memory and neurocognitive function, which is consistent with findings in humans showing that early life sensory overstimulation correlates with cognitive and attention deficits during adolescence. Based on the previously published research, we hypothesized that rats exposed to extended sensory overstimulation during early development will show diminished performance across all behavior tests, although effects may differ by sex. As this study is still ongoing, here we provide an

overview of our experimental design and the behavioral assays used to assess long-term effects of early life sensory overstimulation on behavioral function.

(59)
Detection and Interpretation of Smart Contract Vulnerabilities using Machine Learning and Explainable AI

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Smart contracts are self-executing contracts with predefined terms and conditions, written in code and deployed on a blockchain network. Operating on a blockchain platform such as Ethereum provides a decentralized and secure environment for smart contract execution. Once deployed, smart contracts are immutable and tamper-proof, ensuring that the agreed-upon terms cannot be altered or manipulated. However, when vulnerabilities in smart contracts are present in the code and exploited by hackers, this can lead to significant financial losses. This research focuses on leveraging machine learning (ML) and explainable artificial intelligence (XAI) to detect and interpret smart contract vulnerabilities. While ML algorithms are effective in identifying vulnerabilities, they lack explainability in pinpointing the responsible features. To address this limitation, we incorporate two well-known XAI approaches, SHAP and LIME, which enable us to uncover the critical features contributing to different types of smart contract vulnerabilities. By identifying the code segments associated with these features, we facilitate the removal of vulnerable code and enhance the robustness of smart contracts. The performance of the XAI models is evaluated using metrics such as relevance, accuracy, and consistency, aiding in the selection of an appropriate XAI model. By combining the power of ML algorithms with the interpretability provided by XAI, we enable developers and auditors to gain deeper insights into the vulnerabilities present in smart contract code and to take proactive measures in eliminating them. Through this research, we provide a pathway for securing smart contracts and mitigating the financial risks associated with potential network attacks.

(60)
Real-time Modification of Cell Culture Conditions in Time-lapse Microscopy Experiments through an Adaptive Pump System

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Time-lapse fluorescence microscopy experiments allow for gene expression to be monitored in mammalian cells. However, once initiated, it is difficult to precisely change the experimental conditions, such as drug dosage, which would be a useful feature in inducible gene expression assays. In this study, we developed an automated system to modify the conditions of cell culture during a time-lapse experiment. To accomplish the task we first designed and 3D printed a custom adapter for the cell culture plate which creates an inlet for fluid to be infused directly to the cells. Using this adapter with the syringe pumps, we were able to achieve controlled delivery and withdrawal of growth media in real time. To initially validate our system design, we performed fluid delivery tests using dyes to visualize the efficiency of the pumps. After validating the setup, we used our system to study dox inducible gene expression in HEK-293 cells, varying the exposure time of the cells to the drug to monitor its effect on the gene expression. Data was analyzed with Trackmate-stardist software to identify intensity changes in CFP over time. By using the pump we were able to successfully perturb the growth conditions during the timelapse and observe differential changes in the gene expression profile in accordance to the pumping rates. In the future, we can expand the

capabilities of our system by improving the modularity and flexibility of the adapter, and characterize parameters such as response time, phase delays, and other inducible effects on cells.

(61)
Biosensor Fabrication Using Automatic Liquid Handling Systems and Evaluating its Electrochemical Kd

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Many laboratory experiments require repeated pipetting operations, which in many cases, must be extremely precise in order for the experiment to be performed efficiently. An automated liquid handling system can pipette precise amounts of liquid to specific coordinates. These coordinates are specified in a protocol specifically designed for the task to be performed, which is then sent to the automated liquid handling system for execution. In this way, tedious and repetitive pipetting operations can be performed more efficiently and accurately by eliminating human error. Using this robot, we successfully functionalized the surface of the sensor with an antibody and then determined the electrochemical Kd value using an electrochemical analyzer. Equilibrium binding studies allow the determination of receptor density and the affinity or chemical attraction of a receptor for a particular ligand. The electrochemical Kd value ultimately plays a key role in understanding the equilibrium conditions of a receptor-ligand complex and provides information on the proper incubation times, temperatures, and assay volumes required for a particular experiment.

(62)
Measuring Multi-GPU Programming Performance

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With the rapid advancement of computational power and the growing demand for parallel processing, Graphics Processing Units (GPUs) have emerged as powerful tools for accelerating complex computations across various domains. GPU programming involves harnessing the parallel processing capabilities of GPUs to efficiently solve computationally intensive problems, surpassing traditional Central Processing Units (CPUs).The objective of my research is to evaluate the advantages and disadvantages of multi-GPU computing. To achieve this, I selected a smaller problem for comparison between CPU and GPU performances. The chosen problem was vector addition, a fundamental operation widely used in numerous computational tasks. To begin the experimentation, I implemented the vector addition code in the CPU version and meticulously logged the performance results. This provided a baseline for comparison. Subsequently, I transitioned the program to the GPU version, leveraging the parallelism offered by GPUs. The experimental setup encompassed three different data sizes: small, medium, and large. Additionally, two GPUs were utilized to assess the scalability and performance gains achieved through multi-GPU computing. By measuring and analyzing the performance metrics, including execution time and speedup, I was able to quantify the benefits of GPU acceleration compared to CPU execution. The results of the experiment demonstrated the superiority of GPUs in terms of computational speed, showcasing significant performance improvements over CPUs.Through this research, I aim to contribute to the understanding and utilization of GPUs for efficient parallel computing, enabling researchers to leverage the immense computational power offered by GPUs for their respective domains and applications.

(63)
Dural IL-6 Evoked Migraine-Like Behaviors in Female Mice

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Migraine, a prevalent neurological disorder and one of the major contributors to global disability, disproportionately affects women with a threefold higher prevalence. Despite this striking observation, the factors driving this sex difference and the underlying mechanisms of migraine remain elusive. Interleukin-6 (IL-6), a cytokine implicated in mediating inflammatory pain conditions, has emerged as a subject of interest. Studies have revealed increased levels of IL-6 during migraine attacks, which may indicate its potential role in amplifying pain signals thus contributing to the development of headache attacks. This study aimed to investigate the effects of elevated IL-6 levels in the dura on the manifestation of migraine-related pain behaviors. The mice received a dural injection of IL-6 at a dosage of 0.1 ng. To assess cutaneous allodynia, Von Frey filaments were used to measure sensitivity after dural stimulation with IL-6 injection. Using this preclinical behavioral model of migraine, we showed that the application of IL-6 to the mouse dura mater produces cutaneous periorbital hypersensitivity. Statistical differences were demonstrated using two-way ANOVA followed by Bonferroni multiple comparisons. The findings of this study provide additional evidence supporting the involvement of dural IL-6 in the pathophysiology of migraine, suggesting a model in which dural IL-6 mechanisms contribute to the occurrence of migraine headache attacks.

(64)
Differential Utilization of Low-Level Nutrients by Uropathogenic Escherichia coli and Enterococcus faecalis Using Competitive and Non-Competitive Growth Assays

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Urinary tract infections (UTIs) are the most common bacterial infection with millions of cases occurring yearly. These infections primarily affect women and cost billions of dollars to the U.S. healthcare system annually. The bacterium Escherichia coli is the leading cause of UTIs. Due to the wide genetic diversity in E. coli strains, E. coli is classified into four relevant phylogenetic groups (groups: A, B1, B2, D). Strains from groups A and D (AD) are relatively less common compared to the more frequently isolated strains that belong to group B2 which account for 50-67% of E. coli-caused UTIs. Due to this difference in nature of the groups, we hypothesize that B2 strains of E. coli are better equipped to grow in low-nutrient conditions (similar to that found in the urine environment) compared to AD strains of E. coli. We performed comparative growth curves to assess how various AD and B2 strains grow under starvation conditions such as in a 20% lysogeny broth (LB) media. To understand any possible interactions between E. coli and another common urinary pathogen Enterococcus faecalis, we used dilution spot plating from competitive growth experiments. Finally, we compared the ability of various E. coli strains to thrive when in isolation versus when in co-culture with E. faecalis in different dilutions of media. This work demonstrates that the more pathogenic B2 group thrives in urine-like dilute conditions and outcompetes other species when nutrients are limited, which could contribute to the effectiveness of B2 strains as pathogens compared to AD strains.

(65)
Determining the Neuromodulatory Mechanisms Behind Vagus Nerve Stimulation-Mediated Plasticity and Post-Stroke Recovery

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Strokes are a leading cause of death in the U.S. and impair physical mobility. Vagus Nerve Stimulation (VNS) paired with motor rehabilitation improves motor function recovery by facilitating

neural plasticity. To better inform therapies, studies have found that Norepinephrine (NE) is required for VNS-mediated plasticity to occur, and that increasing VNS intensity increases NE activity in the motor cortex. Previous studies have also characterized the effect of various VNS intensities on plasticity and reported an inverted-U relationship: moderate intensities of VNS increase plasticity, while low and high intensities do not. This suggests a plasticity-stabilizing effect of high-intensity VNS. A better understanding of the mechanism of this stabilizing effect will guide VNS-mediated therapy. This study aims to determine the role of β-adrenergic receptors (β-AR) in VNS-driven motor cortex plasticity. Rats will perform a behavioral task where VNS is paired with jaw muscle activation during chewing. The subjects receive an injection of Propranolol (β-AR-blocker) or saline paired with varying VNS intensities. After the final behavioral session, intracortical microstimulation is used to assess the motor cortex plasticity. Preliminary results suggest that pairing the use of Propranolol with 1.6mA VNS (High-VNS) leads to enhanced plasticity, while, previously, High-VNS without Propranolol has not. Additionally, High-VNS trends towards a greater increase in cortical plasticity than 0.8mA VNS (Moderate-VNS). These results suggest that β-AR activation at higher VNS intensities blocks VNS-driven plasticity. This also provides insight into strategies that can augment VNS therapy to potentially further improve rehabilitation after strokes and other neurological injuries.

(66)
Measuring Lacticaseibacillus Rhamnosus and Lactobacillus Crispatus Growth Rates Within Completely Defined Media

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Lactobacillus is a critically important genus of probiotics found primarily within the human digestive and genital tract. They serve many functions, like fighting harmful bacterial infections in the stomach and bladder, and they are used in numerous probiotics. However, much is still unknown about these bacteria and their functionality. Our research aims to increase the scientific community's knowledge regarding these bacteria, specifically its various strain's growth rates in completely defined media (CDM). We measure the growth rate of two of these strains, Lacticaseibacillus rhamnosus and Lactobacillus crispatus, from which we infer the doubling time and when the bacteria are in the exponential growth phase. To measure the growth rate, we inoculate these bacterial strains into CDM and store them in a hypoxic chamber designed to provide similar atmospheric conditions to the female urogenital tract. At specific time points throughout the experiment the optical density at 600 nm of the culture is measured using the spectrophotometer to measure how much light can pass through the culture and the amount of light absorbed by the culture. We use these measurements to graph the growth curves of each of these strains, and from that, we can determine the exponential growth phase or the time at which bacteria grows the most in the media from which we can find out doubling time. Understanding how quickly and at what rate different Lactobacillus strains grow in carefully provided conditions will help in the effective production of probiotics and assist in the scientific study of Lactobacillus in other experiments.

(67)
Investigating the Fe2+ Translocation and Kinetics Properties of Transmembrane Transporter ZIPCO from Plasmodium Malariae

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Malaria, a predominant tropical disease, is caused by a parasitic infection by Plasmodium falciparum, a unicellular protozoan transmitted through female Anopheles mosquitoes. The parasite relies on the host’s iron resources to grow and replicate in host cells, utilizing various molecular processes, including iron acquisition via the ZIP transmembrane transporters. However, our understanding of the ZIP transporter family, particularly their role in iron uptake for parasitic growth and replication,

remains limited. In vivo studies, reported in literature show that the transmembrane protein ZIPCO is a critical virulence factor that mediates the uptake of Fe2+ to help in the growth of parasites. However, the molecular mechanism by which ZIPCO exerts its function remains poorly characterized. This project employs in vitro studies to investigate ZIPCO's metal selectivity towards different transition metals, their coordination chemistry, translocation kinetics, and transport mechanisms, and thus aims to elucidate the significance of ZIPCO in Fe2+ cellular acquisition and transport. This project will fill the significant knowledge gap in parasitic metal homeostasis and explore the potential of ZIPCO (Fe2+) transporters as targets for drug development against diseases like Malaria. Knowledge of these iron transporters and their role in Fe2+ metabolism could be helpful in future efforts to exploit ZIP proteins as therapeutic targets for the development of treatments for related neglected tropical diseases.

(68)
Optimization and Characterization of an Aconitase-Like Enzyme

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Phytopathogens are microorganisms that induce devastating bacterial diseases to plants worldwide. They severely minimize crop production; bankrupting farm-to-table agricultural businesses, eliminating jobs, and causing food insecurity. Therefore, it is vital to develop a class of antimicrobials that target these phytopathogens to disrupt their development and curb disease. For phytopathogens to develop, propionate, a metabolically generated short-chain fatty acid, must convert to 2-methylcitrate and undergo propionate catabolism. Propionate catabolism is a cycle where propionate breaks down, an essential standard for invading bacteria to survive inside the host. This process is driven by a group of genes termed the prp operon (prpBCDE). The prp operon encodes AcnD, an aconitase-like enzyme controlling metabolic flow. AcnD facilitates the dehydration of 2-methylcitrate, disrupting bacterial propionate catabolism through inhibition. Therefore, we will analyze the structure of AcnD to identify and/or design chemical compounds that can selectively inhibit AcnD enzymatic activity. We optimized the growth process of AcnD within E. coli to determine AcnD activation and observe changes in its expression through purification into a western blot procedure. Future examinations consist of crystallography to discern protein structure. Our objective is to verify these mechanisms to develop novel, sustainable strategies for phytopathogen disease management.

(69)
PyLingual: A Hybrid Approach to Scale Python Decompilation

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Malware, or malicious code, has become an increasing problem as malware writers have started using higher-level programming languages rather than the lower-level languages that were mainly used in the past. Specifically, malware writers are using Python more frequently as the language is compatible with many platforms, has a broad user base, pre-designed modules, and is flexible. This Python malware has become especially difficult to reverse engineer on account of the language updating and releasing new versions every year that current reverse engineering tools cannot keep up with, making the process very labor-intensive. To aid reverse engineers with the important yet difficult task of decompiling intermediate bytecode to readable source code, PyLingual aims to automate the Python decompilation process while also supporting multiple existing Python versions and their evolutions. The framework for this automatic decompilation model is a combination of the most recent Natural Language Processing research and mechanical elements of Programming Language theories. At a glance, PyLingual segments the given bytecode instructions, translates

these segments into source code statements, restores the original code indentations, and verifies the given bytecode and reconstructed source code to be equivalent, all while being completely automated. The research for PyLingual is built upon testing both harmless and malicious Python samples to display the effectiveness of the decompiler. Overall, PyLingual offers a state-of-art Python decompiler to aid the issue of malware abuse that is resilient to rapidly changing Python versions with optimal accuracy.

(70)
MNK Inhibitor Prevents Grimace Pain Responses in Mice

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In the subject of pain management, non-opioid drugs offer several benefits compared to opioid drugs, from reduced risk of addiction and overdose to improved quality of life and long-term outcomes. Here, we test a novel drug, 4ET-D3-03-053, that blocks the MNK-EIF4E pathway, a signaling process known to promote pain in animal models. We tested various drug dosages using the Mouse Grimace Scale, an assay for measuring spontaneous pain in mice. The results of this experiment will aid in future studies to develop more non-opioid drugs.

(71)
Prevention of Modal Alignment using Eigen Analysis and Mode Shape Recognition

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As developments in wind energy continue to grow at an unprecedented rate over the next decade, the demand for larger wind turbines will only persist to increase. Larger turbines tend to have lower natural frequencies due to their size so the chances of them coinciding with a turbine operating frequency, such as the frequency of the aerodynamic load, are increased. Because of this, the dangers of modal alignment or resonance (where an object's operating frequency matches its natural frequency, causing the effects of vibration to be amplified and resulting in modal instabilities and disastrous turbine damage) are increased exponentially. However, these catastrophic effects can be prevented by predicting the natural frequencies of the turbine by implementing eigen analysis method and mode shape recognition techniques using software such as MATLAB. Eigen analysis provides information about modes and mode-shapes (displacements of the blade) whereas mode shape recognition technique provides the contribution of each degree of freedom towards each mode-shape. Through MATLAB, calculated solutions can be more accurate and precise, validating comparisons between natural frequencies and those of aerodynamic loads. Furthermore, MATLAB allows one to visualize the shape and percent composition of each mode within a turbine blade, giving valuable insights to how a structure behaves at its natural frequencies. By using MATLAB to perform eigen analyses and mode shape recognitions, engineers can more accurately constrain and modify a wind turbine to reduce, or prevent altogether, the effects of modal alignment.

(72)
Cetuximab and Indocyanine Green Dye Conjugate as a Potential Immunotherapy Agent

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Photodynamic therapy (PDT) is a method through which light-activable sensitizers (photosensitizers; PSs) are irradiated to elicit a biochemical response within an individual. PSs are molecules that absorb a specific wavelength of light and then release that absorbed energy in different forms, which can lead to specific, controlled reactions within the body. PDT holds significant potential in cancer

research. With sufficient accumulation in tumor cells and irradiation by light, PSs can induce apoptosis through the photodynamic production of reactive molecular species (RMS). Photoimmunotherapy (PIT) has recently emerged as a promising cancer treatment modality, utilizing PS-antibody conjugates to increase sensitizer accumulation in tumor cells. In this research, we conjugated the antibody Cetuximab to the PS indocyanine green (ICG) to increase the specificity of ICG accumulation and RMS production in cancer cells. Cetuximab, a monoclonal antibody, is an FDA-approved cancer treatment that inhibits the external growth factor receptor (EGFR) overexpressed by many cancer cells. ICG is an FDA-approved PS that produces RMS when irradiated, resulting in cell destabilization and apoptosis. By conjugating these molecules (Cet-ICG), we hope to increase tumor specificity and by targeting the EGFR receptor while producing sufficient RMS to induce apoptosis in cancer cells. This two-pronged attack is an example of an emerging technology that can aid in cancer treatment in the future.

(73)
Age-Related Impairments in Trace Eyeblink Conditioning

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Age-related neurodegenerative diseases like Alzheimer's have historically been hard to diagnose, requiring expensive technology. Once symptoms have been recognized, most patients have reached a stage where only palliative treatment can be used to slow its progression. Once the brain deteriorates, it's impossible to restore; thus, diagnosing Alzheimer's early on is vital. Eyeblink conditioning (EBC) is a well-established model of associative learning and memory across aging humans and animals, with two major variants: trace and delay. Delay EBC features an 850 ms conditioned stimulus (CS) followed by a 200 ms unconditioned stimulus (US), which overlap and coterminate. Trace EBC has a 150 ms CS followed by a 200 ms US separated by a 500 ms interstimulus interval. The CS is a binaural tone, and the US is a 2 psi N2 air puff applied to the subject's cornea. Trace EBC is harder to learn, and relies on hippocampal functional integrity, which is impaired by age. Delay EBC relies on lower level brainstem circuitry, and is less impacted by age. We tracked the comparative number of conditioned responses (CRs) and unconditioned responses (URs) for different age ranges. With increasing age, the ratio of trace CRs to URs goes down, with severe impairments beginning in the 40–50 year old range. Due to the inexpensive nature of trace EBC testing in relation to other tests (e.g. MRI, CAT scans, extensive and expensive neurological testing), it could serve as an accessible alternative to investigating and assessing the functional state of the hippocampus in aging.

(74)
Effects of Antibiotic Administration on Pain and Amygdala Activation in Mice

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Antibiotics are among the most widely prescribed drugs in the United States, with their increased clinical use correlating with increases in chronic illnesses e.g., chronic pain. To date, no experiments have directly tested the relationship between antibiotic use and persistent pain. We wanted to determine if and how the most popularly prescribed antibiotics alter pain behaviors in wildtype mice. Using the up/down von Frey test, we assessed hind paw mechanical sensitivity after animals had ad libitum access to vehicle or various classes of antibiotics in their drinking water for seven days. β-lactam antibiotic treatment (e.g., penicillin and ampicillin) decreased animal withdrawal thresholds, suggesting that the β-lactam antibiotics class induces mechanical hypersensitivity in naïve mice. A cecum analysis revealed a higher cecum-to-body mass ratio in mice that consumed ampicillin relative

to mice that ingested other antibiotics or vehicle. To assess the brain regions important for antibiotic-related changes in pain behavior, we used immunofluorescent staining to measure the expression of ΔFosB, a protein observed during addiction and a marker for persistent pain. We completed our analyses in the amygdala— a brain region where pain information converges with subconscious sensory information from internal organs. More ΔFosB-positive cells were observed in the CeA (central nucleus of the amygdala) of mice that consumed ampicillin relative to mice that ingested other antibiotics or vehicle. ΔFosB in the BLA (basolateral amygdala) was consistent among all mice. These experiments support studies that examine the relationship between β- lactam antibiotics and the perception of persistent pain.

(75)
Exploring Binding Between EC12 and the Insecticidal Bt Cry1Ab FSAA with a Fluorescently Aided Assay

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As the global need for nutritious food grows, more attention is spotlighted on the design of effective biopesticides. We are especially interested in a toxin called Cry1Ab which was discovered from Bacillus thuringiensis (Bt) as this toxin targets the Manduca Sexta, also known as tobacco hornworms. As a result of the interactions between the Cry1Ab toxin and Bt-R1 receptor, the midgut epithelial cells launch a signaling cascade toward cell death. Past research demonstrates EC12, an ectodomain of Bt-R1, as the toxin binding site (TBS). Thus, our current research focuses on the receptor binding site in the Cry1Ab toxin that binds to the EC12 receptor. Previous research found that F440 and S441 could be critical sites in the receptor binding region so to confirm this hypothesis, we introduced two mutations which are F440A and S441A (FSAA), purified FSAA, and performed a binding assay with the EC12 receptor from tobacco hornworms. Also, we are fluorescently labeling Cry1Ab to perform a competitive binding assay. Results show that Cry1Ab FSAA can still bind to EC12 but does not compete as well as the wild type so we will investigate other potential sites. Determining this binding interface of Cry1Ab would be impactful to facilitate a design of a novel biological pesticide.

(76)
Feasibility of the X-Maze Reversal Learning Task in a Rat Model of Fragile X Syndrome

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Autism Spectrum Disorder (ASD) is a disorder characterized by repetitive behaviors, social difficulties, and often cognitive issues including deficits in executive function. ASD can be caused by environmental and/or genetic factors, with mutation in the FMR1 gene (causing Fragile X syndrome) being the most common. One form of executive function is reversal learning (RL), the ability to learn a behavior that contrasts with a pre-existing behavior. RL can be assessed in neurotypical rodents with the X-maze behavioral test. We wanted to see if this test could be used in a rat model of ASD. Eight male wild-type (WT) Sprague-Dawley rats were tested, followed by ten male Fmr1 knockout rats. Some of the Fmr1 rats also received stimulation of their left cervical vagus nerve (VNS), a treatment previously shown to have anxiolytic and pro-cognitive effects. The experiment consisted of three days of maze habituation, calculation of turn bias, training against bias, and an RL task. All WT rats and 90% of FMR1 rats passed habituation to the maze, with WT learning faster. Seven of eight WT rats passed turn training of whom four have completed RL. All four tested FMR1 animals have completed turn training successfully. Remaining data from FMR1 rats, including the impact of VNS, are pending. If successful, these results would demonstrate that the X-maze RL test can be used to study

executive function in a genetic ASD animal model, and further that VNS could improve executive function in this model.

(77)
Word Discrimination Along a Speech Continuum in a Rodent Model of ASD

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Autism spectrum disorder (ASD) is a neurodevelopmental disorder that leads to disruptions in the auditory pathway indicated by weaker or delayed neural responses to sound. These alterations cause a cascade of processing errors, resulting in diminished receptive language ability. In rodents, behavioral and physiological abnormalities representative of individuals with ASD can be modeled with prenatal exposure to Valproic acid (VPA). Previously, our lab has reported that VPA-exposed rats have diminished sound-evoked neural responses and an impairment discriminating against similar speech sounds. Here we investigate whether these impaired auditory processes generalize to an impairment in distinguishing between words along a speech continuum. VPA-exposed rats were compared to age matched, saline-exposed, typically hearing rats during a go/no-go sound discrimination task. We expect the results of this experiment to contribute to understanding the relationship between neural impairments caused by ASD and behavioral sound discrimination. This may help develop strategies to improve auditory processing abilities in those with neurodevelopmental disorders.

(78)
Identifying the Hidden Root Causes of Failures in Robotic Systems

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As robotic systems such as those in autonomous vehicles and drones become more pervasive, the need for robust security against system bugs becomes critical. Identifying these bugs rapidly and efficiently could save lives. Generally, code in these systems is run in multiple components (sensor drivers, data processing, etc.) simultaneously. For example, a robot based on the Robot Operating System 2 (ROS 2) is composed of different modules, known as nodes, which contain code for relatively independent functions and communicate with each other via topics and services. However, pinpointing the root causes of bugs is challenging because of the complex data flow inside robotic systems. Traditional debugging approaches (like using the GNU debugger) can only work on a single process. Thus, the goal of our research was to develop a system to help us locate the root cause of bugs in robotic systems.
Our approach utilizes logs and system computational models to locate the root cause. Computational models are built using static analysis techniques. We inserted log statements in the system's source code based on the information extracted from the model. Then, when a bug gets triggered, we analyze the logged data in the context of the model to identify the root cause. Our approach was evaluated on both simulated and real-world robots: Turtlesim and TurtleBot 4. The result shows that our approach can efficiently locate the root cause of the bug.

(79)
Vagus Never Stimulation Decreases Neuronal Activity of the Central Nucleus of the Amygdala During Cue Induced Reinstatement

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Substance use disorder is characterized by the inability to abstain from drugs despite awareness of potential consequences. Environmental cues while taking drugs become associated with reward, making addicts susceptible to relapse. Extinction learning aims to stop drug seeking by pairing the cue previously associated with the reward of drug taking with neutral responses. However, extinction learning is not enough to prevent drug seeking. Pairing extinction with vagus nerve stimulation (VNS) helps reduce drug seeking when re-exposed to the cue, but not much is known about the exact mechanisms through which VNS modulates drug seeking. One potential brain region to observe is the central nucleus of the amygdala (CeA). The CeA regulates stress, motivation, and habitual behavior, all of which are implicated in drug seeking. We hypothesized that changes in the activity of neurons in the CeA contribute to how VNS can reduce drug seeking during reinstatement. To conduct our experiment, the rats self-administered cocaine for 15 days, then went through extinction learning paired with either VNS or sham stimulation for 10 days. Animals went through reinstatement of drug cues and were then sacrificed. The brain tissue was stained for cFos protein to mark neuronal activity. We analyzed the tissue to compare the number of cFos+ cells in the CeA of animals that received VNS and sham stimulation. There was a significant decrease in cFos+ cells in the CeA of animals that were treated with VNS, which implies that there is decreased CeA activity during drug-seeking in animals that received VNS.

(80)
CARE With Alexa: Integrating Amazon's Alexa into Virtual Reality Environments for Enhanced User Interaction

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As virtual reality (VR) developers continue to strive to enhance accessibility and immersion in their projects, it is only natural to integrate elements that have become more commonplace in recent years. One such example is the integration of smart assistants like Amazon's Alexa in VR, empowering users to use their voice and headset microphone for real-world commands, such as controlling music and lights in the virtual environment, via a system that enables users to seamlessly control their Alexa devices through immersive VR experiences. This provides a natural and intuitive control scheme in VR. Furthermore, we discuss the technical aspects of our proposed system, including the VR interface design, device integration for the popular VR platform Meta Quest 2, and user interaction examples. Additionally, we seek to add to the concept of virtual collaborative work environments through MetaTwin by increasing its accessibility as we believe through proper continued innovation in the idea of voice assistance and virtual reality, disabled individuals may be granted the opportunity to fully join the workforce.

(81)
Through the Sacred Lens: The Association of Religious Affiliation, Commitment, and Orientation with Body Image and Anti-Fat Attitudes

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Religious commitment confers benefits related to body image, including promoting body esteem and satisfaction. However, less is known about the roles of religious affiliation, commitment, and orientation in the promotion of healthy body image. Thus, in Study 1, we examined whether religious affiliation, the strength of one's religious commitment, and intrinsic (feeling personally motivated to integrate religious values into daily life) or extrinsic (practicing religion to achieve external goals like wealth, status, or to please others) religious orientation relate to body image. Additionally, because

there is scant past research on how these constructs relate to attitudes toward others' bodies, we also examined how these constructs relate to anti-fat attitudes. In Study 2, we conducted a content analysis of sacred passages focusing on body image from four major world religions to provide additional insight into the role of religion. For Study 1, 316 participants completed online questionnaires about religious affiliation, commitment, and orientation, weight-related body esteem and body dissatisfaction, and the anti-fat attitudes of dislike, willpower, and fear of fat. Study 1 found a significant positive correlation between intrinsic orientation and body esteem, illustrating that intrinsic motivation to practice religion is associated with more positive body image attitudes toward oneself, but not toward others. Study 2's content analysis suggested some variability in the way religious texts discuss body image, but some common themes emerged, including investment in body care. Future research may want to consider whether intrinsic religious orientation has the same connections to body image across different religious affiliations.

(82)
Solving TEAD's Secondary Structure using MD Simulations

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TEA Domain Transcription Factors, known as TEAD proteins, are present in various organisms. TEAD proteins have 3 parts: a DNA-binding domain, an unsolved middle region, and a protein-binding domain. These proteins require specific transcriptional co-activators, namely YAP (yes-associated protein) and TAZ (transcriptional coactivator with PDZ-binding motif), to initiate the transcription of DNA. They play a critical role in a chain of reactions called the Hippo signaling pathway; when the pathway is off, TEAD binds to the co-activators which contributes to cell proliferation and tumors. Previous studies have focused on developing inhibitors that target the protein-binding domain of TEAD and disrupt the interactions between TEAD and YAP/TAZ proteins, thus reducing cell proliferation. These inhibitors have potential applications in the development of drugs, particularly for treating conditions like malignant mesothelioma (cancer affecting lung tissue), where the YAP/TAZ-TEAD complex tends to be hyper-activated. To deepen our understanding of TEAD proteins and facilitate the development of more effective inhibitors, our research focused on modeling the structure of the middle region of TEAD. To accomplish this, we conducted molecular dynamics (MD) simulations that model how TEAD folds over time. The MD simulations demonstrated promising outcomes, revealing a more defined secondary protein structure that included bends, turns, and beta-turns in the middle region. By utilizing the complete structure of a TEAD protein, researchers can potentially develop novel inhibitors targeting the entire TEAD molecule, thus further inhibiting the cancerous YAP/TAZ-TEAD complex.

(83)
Identification of GPR88 as a Potential Target for Treating Chemotherapy-Induced Peripheral Neuropathy

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Chemotherapy-Induced Peripheral Neuropathy (CIPN) is a distressing and painful condition experienced by cancer patients undergoing treatment with agents like paclitaxel and oxaliplatin. Notably, the intensity of pain can worsen with subsequent treatments due to toxicities within the dorsal root ganglia (cell bodies that transmit sensory information), nerve degeneration, and the transition to a chronic pain state known as hyperalgesic priming. In this state, pain is described as more severe in the second instance, after the body has healed and reached what is called the resolution phase. This study aimed to investigate the nociceptor-enriched genes that are translated

during the resolution phase in paclitaxel-treated animals using the technique of Translating Ribosome Affinity Purification (TRAP). Through our analysis, we identified significant upregulation of G-protein-coupled receptor 88 (GPR88) during the resolution phase in animals treated with paclitaxel. To assess the role of GPR88 in hyperalgesia, we conducted behavioral pharmacology experiments using IL-6, an inflammatory cytokine, to measure pain thresholds using the Von Frey test. Animals injected with GPR88 during the resolution phase of this inflammatory pain model exhibited increased mechanical hypersensitivity and grimacing. Our findings suggest that GPR88 is involved in hyperalgesic priming and propose that targeting this G-protein-coupled receptor with specific antagonists holds promise for further development as a potential treatment for CIPN.

(84)
Computational Study of Human DNA Polymerase λ and Two Cancer-Associated Single Point Mutations

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A protein is composed of amino acids that can form one or more chains that fold and combine into a structure determined by the amino acid sequence. Changes in the nucleotide sequence of DNA coding for a protein may result in cancer. Bioinformatics identifies mutations in the genome, the most common being Single Nucleotide Polymorphisms (SNPs). These SNPs can be associated to different diseases such as cancer so scientists can analyze the consequences of mutations on a molecular level. The Cisneros group developed a method to uncover cancer-associated SNPs on particular proteins, and investigate their impact on the protein structure using computational modeling. In this research, two cancer mutations on DNA polymerase l (Poll), a DNA polymerase involved in the repair of DNA, are investigated. The initial crystal structure of Poll is remodeled in UCSF Chimera with Alpha Fold to include missing residues and remove residues 1 to 200. To understand the structural and functional impact of two cancer SNPs in Poll, we use Chimera to substitute Threonine in residue 221 with Alanine and Proline in two separate replicate systems and compare them with the wildtype system. We prepared 3 replicates of each system to improve the accuracy of analysis results. To prepare the protein we added potassium atoms and solvated the systems using tleap, conducted minimization, heating, and equilibration, and ran production for 500 nanoseconds using AMBER Molecular Dynamics. Analysis of the trajectories indicates the systems are stable and ready for further analysis to help find the mutations' impact.

(85)
Application of Polymer-Coated Supports for Carbon Molecular Sieve Membranes

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The rise of energy costs has highlighted the crucial role of membrane technology in gas separation, as it significantly reduces both environmental impact and production costs. Carbon-based gas separation membranes present distinct advantages over conventional methods such as cryogenic distillation and amine absorption. These advantages include low capital and operating costs, minimal energy requirements, ease of operation, and environmental friendliness. Carbon molecular sieve membranes (CMSMs) exhibit higher diffusion rates and selectivity for gases than polymer membranes and mixed-matrix membranes. However, a notable drawback of CMSMs is their fragility, necessitating the use of porous supports to minimize the risk of membrane breakage. Polymer materials are used as precursors in the development of CMSMs. In this project, Matrimid-5218 and polybenzimidazole (PBI) were chosen as precursors. Matrimid is a polyimide that is used in

membrane development due to its high glass transition temperature (Tg), permeability, high solubility, and high temperature resistance. PBI was used due to its high Tg and thermal stability, and high carbon content. Polymer-coated supports, primarily composed of alumina, enhance the stability of carbon membranes. Polymer-coated supports are defined as thin layers of polymer applied to the flat surfaces of the support which are required for the pyrolysis of the polymer in the fabrication of CMSMs. Consequently, carbon membranes exhibit high selectivity due to the well-defined pores that efficiently separate small molecules from larger ones, improving the efficiency of the separation process.

(86)
Development of Nd2O3-Templated Carbon for Supercapacitors

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In an increasingly technological world, there are growing demands for efficient, high-capacity energy storage devices. Batteries store large amounts of energy, but discharge energy slowly. Meanwhile, capacitors discharge energy quickly, but cannot hold large amounts of charge. Supercapacitors offer a promising solution, combining the benefits of low-efficiency, high-storage batteries and medium-storage, high-efficiency capacitors. Supercapacitors are electrochemical energy storage devices that store electrical charges on electrode surfaces via redox reactions or physical adsorption. Electrostatic double-layer capacitors (EDLCs) use adsorption, while pseudocapacitors (PCs) use redox reactions. Due to oxidation-reduction reactions, PCs have high energy density but low power density. Contrastingly, EDLCs have high power density and a long cyclic life, but their energy density is limited to the surface area of the electrode. Consequently, EDLCs are usually made from carbon-based material with a high surface area. Recently, a new class of supercapacitors, i.e. hybrid supercapacitors, received significant attention because of their potential to overcome the individual limitations of EDLCs and PCs. Thus, our study aims to synthesize carbon with a high surface area on redox-active neodymium (III) oxide (Nd2O3) templates to use as an electrode material for hybrid supercapacitors. In the electrodes, Nd2O3 acts as a source for PCs, while deposited carbon on the surface of Nd2O3 acts as a source for EDLCs. The synthesized material is characterized by transmission electron microscopy (TEM), scanning electron microscopy (SEM), x-ray diffraction (XRD), and thermogravimetric (TGA) analysis.

(87)
A Novel Variant of the Aquaporin-4 Water Channel Regulates Collagen Type-IV Expression in the Brain

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Aquaporin-4 (AQP4) is a transmembrane protein found in astrocytes (common non-neuronal cells found in the central nervous system) and is involved in the homeostasis of water, pathobiology of neurological diseases, and clearance of waste products through the glymphatic (glia & lymphatic) system in the brain. Recently, our lab has discovered a new variant of AQP4, termed AQP4X, which arises from stop codon readthrough of the Aqp4 mRNA and is localized exclusively perivascularly (around blood vessels). Further, by generating mice that lack AQP4X (Aqp4_NoX) or overexpress it (Aqp4_AllX), the lab has demonstrated a role for this variant in the clearance of amyloid-beta (Aβ), a peptide that can otherwise instigate Alzheimer's disease. Here, we sought to investigate the role of AQP4X in the extracellular spaces around the blood-brain barrier (blood vessels around the brain), with a particular focus on Collagen type IV (COL-IV). COL-IV is a type of collagen found primarily along the extracellular matrices of endothelial cells, which are the cell layers that line around blood

vessels. Previous studies have shown that COL-IV inhibits Aβ fibril formation, thus potentially decelerating Alzheimer's disease. We examined the expression of COL-IV relative to AQP4X in the cerebral cortex of the brain using immunofluorescence staining. We show that the expression of COL is reduced in the cerebral cortex of Aqp4No_X mice compared to Aqp4_AllX and wild-type mice. Our results may have therapeutic significance regarding Alzheimer's disease given that COL-IV also plays a role in reducing Aβ build-up.

(88)
Community participatory approach to improve understanding of sleep quality in Hispanic/Latino families

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The goal of our proposed study is to use a community participatory approach to better understand predictors of sleep quality and identify targets of intervention to improve sleep in Hispanic/Latino families. To aid in preparing the grant proposal, a Community Advisory Board was convened to obtain input on study goals and ensure that the proposed study is relevant and beneficial to the Hispanic/Latino communities in the DFW area. Based on this meeting, we sought to include assessments of child sleep and cultural influences on family interactions including gender roles in childcare, isolationism, language barriers, multigenerational homes, and religiosity. We sought measures of these constructs and took into account their length, their validity, how widely they're used, and whether they've been translated into Spanish. This grant proposal will be submitted to the National Institutes of Health. The importance of using a community participatory approach will be discussed.

(89)
Redefining Accessibility: An Empirical Analysis on the UI/UX Issues of Mobile Applications

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Mobile accessibility ensures that individuals with disabilities can effectively use and engage with mobile applications. Current accessibility measures often remain inconvenient for users with disabilities. For instance, while existing features can read the content descriptions of UI components, they often lack the ability to provide interactive feedback or perform actions in response, hindering a seamless user experience and hampering their ability to perform tasks independently. To bridge the gap, we propose a framework that can provide interactive feedback between users and applications. Our project mainly includes two parts of efforts: (1) we create a dataset that includes UI screenshots and layout information of the most popular apps from various categories; (2) we modify the Contrastive Language-Image Pre-training (CLIP) model to improve UI/UX design and accessibility for users with diverse needs and enhance mobile accessibility. For the former, we utilize APE, a fully automated model-based testing tool, to generate screenshots of various apps at different screen states as well as the corresponding layout information, e.g., UI hierarchy and element attributes. For the latter, we leverage the CLIP algorithm, a pre-trained model capable of cross-modal understanding, as a reference to analyze the XML files in conjunction with textual descriptions, aiming to identify accessibility barriers and areas for improvement. CLIP's focus on its output is classification, however, given that was not the output we intended, we looked towards modifying the algorithm to better suit our task.

(90)

Advancing Chronic Pain Research: Insights through Molecular Analysis and Gene Editing Techniques

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In 2021, about 20.9% of U.S. adults experienced chronic pain, with 6.9% experiencing high-impact chronic pain. Treating chronic pain can be challenging, partly due to the difficulty in translating research findings from mice to humans, especially in drug development and understanding disease states. However, there are techniques available to advance chronic pain research. By identifying proteins involved in the ascending pain pathway, potential biomarkers can be discovered, providing insights into pain mechanisms. Currently, clustered regularly interspaced short palindromic repeats (CRISPR), a gene editing tool, has helped in identifying specific genes and their contribution to pain phenotypes in both mice and cells. Transient receptor potential vanilloid-1 (TRPV1), found in pain-sensing neurons, is activated by noxious heat and trigger pain signals in the central nervous system. To study this channel, protein analysis was conducted on mouse spinal cords and human dorsal root ganglia (DRG) cells, including knockout cells treated with CRISPR. The differences in TRPV1 expression were visualized using a western blot assay, suggesting that techniques employed in chronic pain research will assist in the development of treatments for chronic pain.

(91)
Determining the Role of ANO1 in Modulating Transcription and Apoptotic Processes of KSHV-Infected Endothelial Cells

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Kaposi's Sarcoma is a malignant, currently incurable cancer derived from Kaposi's Sarcoma Herpesvirus (KSHV) commonly found in immunocompromised HIV/AIDS patients of Sub-Saharan Africa. While KSHV remains predominantly latent within endothelial-originated spindle cells, its shift to lytic replication promotes a signal transduction that inhibits cell death. Our preliminary data shows that viral G Protein-Coupled Receptor (vGPCR) induces an upregulation of anoctamin-1 (ANO1), a transmembrane calcium-activated chloride channel, which is required for vGPCR-mediated inhibition of host cell death. However, the precise role and positioning of ANO1 in the signaling pathway of vGPCR is unclear. To further amend this gap in knowledge, we hypothesize that treating human dermal microvascular endothelial cells (HMEC1) with various inhibitory drugs, namely diethylstilbestrol (DES) and wortmannin, will reproduce preliminary data. From this drug study, we anticipate reductions in calcium levels, cyclooxygenase-2 (COX-2) levels, protein kinase B (Akt) levels, and elevated cell death measured by trypan blue staining to ultimately determine final variances in ANO1 expression and channel activity. Our goal is to study the effects of ANO1 siRNA knockdown on apoptosis, elucidating the mechanism of ANO1 in KSHV and developing a track toward exploring the remainder of the vGPCR-ANO1 pathway, such as its potential correlation with COX-2 regulation. Thus, additional target candidates can be identified for the advancement of KSHV oncogenesis therapeutics.

(92)
Using Fluorescent in situ Hybridization (FISH) to detect the genus of different bacteria using genus-specific probes

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Urinary tract infections (UTIs) are the most common bacterial infections among adult women. Approximately 150 million women worldwide suffer from UTIs each year. Recurring UTIs (rUTI) are defined as more than 3 UTIs in a 12-month period or 2 UTIs in a 6-month period. Fluorescent in-situ Hybridization (FISH) is a technique that allows for probes to attach to the 16s rRNA region of bacteria in bladder biopsy tissues for their identification. The 16s rRNA region is a good target as ribosomal RNA is present in all living organisms and is relatively stable with variable and conserved regions. Using a universal probe that targets all bacteria, De Nisco et. al. had analyzed the urine and bladder biopsy samples from postmenopausal women and found direct evidence that bacteria reside in the bladder wall of postmenopausal patients. However, such universal probes are unable to identify the specific genera of the bacteria. The goal of this project is to test genus-specific probes that would enable us to detect bacteria at genus-level in the bladder tissue. Our results determined that the Escherichia genus probes effectively stained the gram-negative uropathogen Escherichia coli. We observed strong fluorescence with both the universal and genus specific probes. In the future, we would test the ability of Enterococcus and Staphylococcus-specific probes to detect gram-positive bacteria like Enterococcus and Staphylococcus to see if the genus can be accurately detected and distinguished.

(93)
Predicting Lung Cancer from Risk Factors Using Neural Networks

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Lung cancer is the leading cause of cancer deaths in the nation. However, early detection of the disease significantly increases patients' survival rates by potentially allowing treatment to start before the disease has the chance to spread. This project explores the use of machine learning to predict lung cancer from factors a patient would readily know, such as smoking history, coughing, and age. An artificial neural network was given a dataset of lung cancer patients and trained to find relationships between 15 attributes and whether the respective patient has cancer. The resulting machine learning model is capable of taking data from a new patient's reported attributes and reporting if those features correlate with those of someone with cancer. Due to the dangers of falsely reporting that someone is not likely to have cancer when they do, a special focus was put on minimizing this type of error. The final model was tested to have an overall accuracy of 91.5% while correctly identifying the patients who had cancer 96.5% of the time. This machine learning model can be an excellent screening tool.

(94)
Hexaphenylbenzene-based Metal-Organic Polyhedra for Carbon Sequestration

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As atmospheric carbon dioxide levels have risen, there has been an urgency to find effective carbon sequestration methods. Metal-organic polyhedra (MOPs) are a potential solution; these porous, three-dimensional molecules consist of metal ions coordinated with organic ligands, offering tunable internal volumes and active sites for selective gas binding, which gives them a wide array of applications. More specifically, MOPs exhibit promising capabilities for capturing carbon dioxide from flue gas by sequestering the molecules within their pores, thereby mitigating greenhouse gas emissions. In this project, we synthesized a MOP using copper ions bonded with a

hexaphenylbenzene-based isophthalic acid derivative. To obtain the hexaphenylbenzene ligand, we employed a three-step process. In the first step, tetraphenylcyclopentadienone was synthesized via the Knoevenagel condensation, providing the necessary phenyl groups. After, the Sonogashira coupling reaction was used to produce an isophthalate functionalized diphenylacetylene, a compound crucial for introducing carboxylate functional groups. These two compounds were then used in an inverse electron demand Diels-Alder reaction, resulting in the production of a novel hexaphenylbenzene compound in 70% yield. Currently, we are investigating the binding between this organic ligand and copper ions, with the goal of forming crystalline structures capable of effectively capturing carbon dioxide or other gases. Although further experimentation is required to optimize this structure and its synthesis, our research on the synthesis of hexaphenylbenzene-based MOPs expands the library of porous hybrid structures and their possible applications, especially towards the advancement in addressing global carbon emissions.

(95)
Optimization of Protein extraction from viral-GPCR overexpressing cells using Membrane Protein Specific Lysis Buffers

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Kaposi's Sarcoma-associated Herpesvirus (KSHV) is an oncogenic herpesvirus known to be the causative agent of KS. Kaposi's Sarcoma (KS) has a high prevalence in Sub-Saharan Africa, Mediterranean countries, and transplant populations. In KSHV-infected cells, the viral G-protein coupled receptor's (vGPCR) downstream interactions are hypothesized to be integral to the proliferation and genesis of KS. Our current Protein-Protein-Interaction (PPI) project intends to identify interactions between host proteins and vGPCR that are critical for infection. Traditionally, PPIs are validated by co-immunoprecipitation (co-IP), which relies on western blot (WB) analysis. However, RIPA extraction buffer appears to insufficiently lyse the plasma membrane where vGPCR localizes, preventing further analysis. Our summer project was to determine the ideal extraction buffer to properly lyse vGPCR from the plasma membrane and visualize it on a WB. The procedure involved the identification and use of several extraction buffers (e.g. 1% CHAPS). CHAPS showed better cell lysis under microscopy in the supernatant, indicating a higher chance of detectable vGPCRs than the RIPA buffer. In the future, the protein isolated from these buffers will be quantified using a Western Blot to validate this hypothesized improved extraction.

(96)
Differences in the Association Between Gestures in Early Development and Later Language Abilities in Autistic and Non-Autistic Toddlers

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Research shows that gestures in early development are positively associated with development of later vocabulary skills, in both non-autistic and autistic children. However, autistic children are less likely to produce gestures. The current goal of the study is to look at how lower early gesture skills are associated with later language skills in autistic toddlers when compared to non-autistic toddlers. We hypothesize that autistic toddlers will have lower later vocabulary skills compared to non-autistic toddlers due to lower early gesture skills.
Using data from the Infant Brain Imaging Study (IBIS), we used linear regression to evaluate group differences in the association between total gestures at 12 months and vocabulary understood at 24

months of age in autistic and non-autistic children using the MacArthur-Bates Communicative Development Inventory – Words and Gestures. The IBIS study includes children with either high (HL) or low likelihood (LL) of developing ASD based on if they have an older sibling with ASD. Participants were separated into three groups: HL infants who met criteria for ASD at 24 months (HL-ASD), HL infants who did not meet criteria for ASD 24 months (HL-Neg), and LL infants who did not meet criteria for ASD at 24 months (LL-Neg).
Results indicated that there were differences in the association between gestures in early development and later receptive vocabulary when comparing the HL-ASD group to the HL-Neg group. Given our results, when autistic children are compared to non-autistic children, early gestures may not have the same supportive developmental effect later vocabulary skills.

(97)
Evolutionary Sacrifices by Staphylococcus aureus in Ciprofloxacin Resistance

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The anti-bacterial novel drug discovery pipeline is failing as bacteria evolve resistance to antibiotics faster than new drugs can be discovered, threatening to topple infectious disease care. Staphylococcus aureus is a particularly concerning pathogen as it has the propensity for high levels of antibiotic resistance, leading it to be a major cause of death worldwide. Previous studies have observed different antibiotic susceptibility phenotypes when methicillin resistant S. aureus (MRSA) was grown in standard bacteriological and cell culture media. Cation adjusted-Mueller Hinton Broth (CA-MHB) is used as a standard bacteriological medium in clinical antibiotic susceptibility testing, however RPMI–a standard cell culture medium–is more representative of host physiological conditions. In this study, we sought to understand the evolutionary sacrifices that S. aureus would have to make to gain resistance to fluoroquinolones. This was done by evolving clinical MRSA to be resistant to the fluoroquinolone ciprofloxacin (CIP) and evaluating their phenotypes in both bacteriological and cell culture media. We found CIP resistance did not confer resistance to the macrolide azithromycin, indicating that evolution of resistance is specific to CIP. We further observed that the CIP resistant strains had an altered colony morphology, forming smaller sized colonies than the wildtype. The CIP resistant strains had alterations in their growing patterns indicating changes in overall fitness. This study highlights that to gain resistance to ciprofloxacin, S. aureus makes evolutionary sacrifices regarding its cell morphology and fitness. Future studies will examine the mechanisms behind these changes.

(98)
Analyzing the changes in phosphorylated eIF4E levels and MNK activity during cortical development

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Background: Cortical development is a complex process crucial for creating functional neural networks, controlled by molecular mechanisms like protein synthesis. Studies show that eukaryotic initiation factor 4E (eIF4E) plays a pivotal role in protein synthesis regulation. MAPK-interacting kinases (MNK) regulate eIF4E through phosphorylation; however, MNK's role in cortical development is still unclear. In this experiment, we utilized western blotting to determine changes in phosphorylated eIF4E (p-eIF4E) levels at various stages of cortical development, to assess changes in MNK signaling in the cortex.

Methods: We used cortical samples from mice (previously obtained in the lab) at critical stages of

cortical development: embryonic days (E) 16 and 18, postnatal day (P) 0, and adulthood. We prepared total protein extracts, and performed two western blot analyses, with one analysis utilizing eIF4E-specific antibodies, and the other employing p-eIF4E-specific antibodies.

Results: We observed that total cortical eIF4E levels decrease with age, while changes in p-eIF4E levels are insignificant between E16 and P0, but decline during adulthood. To confirm that changes in p-eIF4E levels were not caused by parallel changes in total eIF4E levels, we then normalized our phosphorylated results to the total protein levels to determine the real change in p-eIF4E levels. After normalization, we saw a significant increase in p-eIF4E levels from E16 to P0.

Conclusion: From E16 to P0, p-eIF4E levels increased significantly, indicating that MNK activity also increased during this time. Future studies will examine the downstream impact of this increase in MNK activity on protein synthesis at different stages of development.

(99)
Optimizing Human Nucleosome Reconstitution Methods

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In eukaryotes, histones allow more than three billion base pairs of DNA to fit inside the nucleus of a cell. Two copies of four core histone proteins (H2A, H2B, H3, and H4) are wrapped by 147 base pairs of DNA to form the nucleosome, a complex critical to DNA condensation and regulation. H3.3 is a variant histone involved in regulating gene expression through its presence in transcriptionally activated genes. Mutations in H3.3 are linked to human cancers such as pediatric high-grade glioblastoma and bone tumors. H2A.Z is another variant histone essential to the function of RNA polymerase II, cell differentiation, and neural activity. It has been linked to breast, prostate, colorectal, liver, bladder, and lung cancers. Identifying dynamic changes caused by human H2A.Z, H3.3, and H2A.Z/H3.3 (double variant) in nucleosomes can give insight into the molecular basis for observed differences in biological systems. Human nucleosome assembly in vitro poses many challenges such as precipitation, lengthy dialysis steps, and limited yields. Our project addresses these obstacles by optimizing the nucleosome assembly protocol. We identified that incremental salt concentration decreases from 2.0 M to 0.2 M over an extended period (40+ hours) prevents nucleosome precipitation. We observe higher yields when targeting higher concentrations (above 8 µM). We also show that PlusOne dialysis containers facilitate the most efficient recovery of samples compared to D-Tubes or Dialysis Buttons. This optimization allows for comparing conformational changes and binding interfaces between variant and wildtype human nucleosomes with hydrogen-deuterium exchange coupled to mass spectrometry (HDX-MS).

(100)
Optimizing Western Blotting Techniques Using Homogenized Brain Tissue

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Proteins can serve as important biomarkers that can be used to characterize the activity of regions in the central nervous system in different disease states. Two popular methods of measuring protein expression are immunohistochemistry (IHC) and western blotting. Although IHC is useful for obtaining spatial information, using the western technique is a quicker way to analyze protein from homogenized tissue and gather information about protein expression of an entire area of tissue. The general western blotting technique consists of an electrophoretic separation of proteins followed by a transfer of the protein bands onto a membrane matrix. After transfer, the process is followed by

immunoblotting to detect specific proteins. Although western blotting is an effective method and more efficient than IHC for quantifying protein expression, the typical “wet transfer” process is time-consuming and produces excess methanol waste. An alternative to the wet transfer is the “semi-dry” transfer, which can be performed in under 10 minutes and produces considerably less waste. However, due to the nature of a semi-dry transfer, proteins can be incompletely transferred or produce excess background signal on the membrane. Utilizing both techniques, we performed western blots on homogenized CeA tissue, and compared the results of using a wet transfer to a semi-dry transfer. The goal of running both transfer techniques is to optimize our western blotting protocol to consistently produce comprehensible results in the most efficient way possible.

(101)
Generation of 3D Models of Objects from Partial 2D Visual Input

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In recent years, research in computer graphics has moved toward the usage of Neural Radiance Fields (NeRFs) as a way to represent and interact with 3D models and scenes. NeRF renders 3D objects by utilizing deep learning algorithms to generate a 3D object from multiple multiple sparse viewpoints of the object and preserving the spatial information allowing it to be manipulated. This concept allows for a wide variety of applications, including game development, virtual and augmented reality, and medical imaging. Currently there are many limitations to using NeRFs, as it requires a large amount of training data of high resolution images in order to construct 3D models. For our research, we used NeRFstudio to create, train, and visualize 3D renders of real world data captured from a mobile camera, which will allow this technology to be more accessible to the public in the future. After we trained NeRFs with images of office chairs, we found that mobile features like “burst photos” allow for more visual overlap of the scene which increases the chances of successful processing. However, the lower resolutions of the mobile images themselves, as compared to oft-used professional cameras, created deformed models. Our research is not yet complete, but we anticipate that the use of NeRFs to scan real world objects into 3D models will lead to better results and revolutionize the way we interact with physical objects in virtual environments.

(102)
Unmasking Hate Speech in Memes: A Deep-Learning Approach for Multimodal Analysis

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Memes have gained widespread popularity as a means of sharing humorous content through modern communication channels. However, certain combinations of text and images can transform innocent memes into vehicles for disseminating hate speech. The complex multimodal nature of memes presents challenges in accurately identifying and addressing hateful instances. To tackle this issue, we propose a deep-learning neural network framework that combines text and image embeddings to effectively detect hate speech within memes.

We used the Meta Hateful Meme Dataset which includes instances of memes that can only be accurately classified when both their text and images are taken into account coherently. The text component of the meme was extracted, and was passed through TF-IDF to obtain the text embedding, and the image component was passed through a CNN for the image embedding. Then, our approach was evaluated using two fusion methods: early fusion, which merges image and text embeddings before processing them through the neural network, and late fusion, which independently processes the image and text embeddings and combines them at the decision-making

stage. The early fusion approach yielded a model with the highest accuracy and F1 score.

Our study contributes to a deeper understanding of multimodal memes, their capacity for propagating hate speech, and the necessity for effective detection and mitigation strategies. These findings hold implications for the development of strategies that can more efficiently detect and prevent the proliferation of hate speech, ultimately fostering a safer and more inclusive digital environment.

(103)
The role of brown adipocyte toll-like receptor 4 (TLR4) in thermogenesisThe role of brown adipocyte toll-like receptor 4 (TLR4) in thermogenesis

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Obesity affects over a billion individuals in an escalating global epidemic. This chronic disease is associated with low-grade inflammation, characterized by elevated circulating lipopolysaccharide (LPS) levels and increased inflammatory cytokines in various tissues. The brown adipose tissue's (BAT) ability to conduct thermogenesis has justified the analysis of its pathways due to its possible role in obesity treatment. However, obese mice and LPS-treated mice exhibited reduced heat production and decreased expression of uncoupling protein 1 (UCP1), a key regulator of thermogenesis. This suggests that inflammation in BAT leads to decreased UCP1 expression and reduced thermogenic capacity. Since toll-like receptor 4 (TLR4) is the cell membrane protein mediating LPS-induced inflammatory response, we hypothesize that blocking LPS-TLR4 signaling in brown fat depots can enhance thermogenic effect in mice.
Two strains of mice were generated to test our hypothesis: TLR4 floxed (Tlr4fl/fl) and brown adipocyte TLR4 deficient mice (Tlr4BKO). Before conducting the experiments, we performed PCR and qPCR analysis to confirm the deletion of TLR4. The mice were treated with LPS (7.5µg/mouse) by injection every other day for 2 weeks. In addition, CL316, 243 (CL agonist, 1mg/kg body weight) was injected to mice for the last 7 days to stimulate thermogenesis. At the end of the treatment, mice were anesthetized for tissue collection. The UCP1 expression in BAT were analyzed using Western blotting. Surprisingly, we found that Tlr4BKO mice had slightly reduced UCP1 expression in BAT. In the future, we will examine whether BAT TLR4 deficiency affects UCP1 expression in subcutaneous white adipose tissue (subWAT), which is another tissue involved in thermoregulation.

(104)
Role of Annexin in YAP RegulationRole of Annexin in YAP Regulation

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The Hippo signaling pathway has been identified as a significant contributor to the development of human cancers, through dysregulated YAP protein. However, directly targeting YAP has proven challenging due to its disordered structure. Consequently, the focus has shifted to investigating the upstream proteins that regulate YAP by modulating Hippo signaling. Of particular interest is Annexin A7, a protein that is overexpressed in many cancers, yet its exact role remains elusive. Here, we tested the hypothesis that Annexin A7 binds to MOB1A, leading to decreased LATS phosphorylation and subsequently reducing YAP phosphorylation. To investigate this, ANXA7 was subcloned into a mammalian expression vector, transfected into human embryonic kidney cells, and the effect on YAP phosphorylation was analyzed using SDS-PAGE and Western blotting. Our results showed

successful ANXA7 cloning, with the transfected cells exhibiting elevated ANXA7 concentrations, as well as lower concentrations of phosphorylated YAP in the transfected cells. These findings suggest that AnnexinA7 may play a role in YAP regulation within the Hippo pathway. Future experiments will further examine how ANXA7 regulates YAP activity.

(105)
Influence of Adipocyte Progenitors on a Mammary Cancer Cell LineInfluence of Adipocyte Progenitors on a Mammary Cancer Cell Line

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According to the CDC, breast cancer is the second leading cause of cancer death in women. A major challenge in treatment is the gap in our knowledge regarding cellular contributions to breast cancer. A deeper understanding of the cells that promote tumorigenesis can help us design improved therapies for breast cancer. Crosstalk between adipocytes in the breast stroma and cancer cells has been shown to promote growth and migration of the breast cancer cells. However, the effect of immature adipocytes, referred to as adipocyte progenitors (APs), on breast cancer cells is not known. In this study, our objective was to determine the influence of APs on the growth and migration of breast cancer cells. Specifically, we examined the effects of conditioned media derived from APs on a murine mammary cancer cell line. We found that cell proliferation marked by Ki67 was increased in mammary cancer cells exposed to AP-conditioned media. Furthermore, we studied mammary cancer cell viability and migration following culture in AP-conditioned media. Cancer cells grown in AP-conditioned media exhibited morphological changes, resulting in a fibroblast-like, motile phenotype. This data suggests that adipocyte progenitors may alter proliferative and morphological characteristics of mammary cancer cells, which warrants further investigation into their precise role in breast cancer.

(106)
Conversion Study of Bromine-Magnesium Exchange Process During Grignard Metathesis Polymerization of Poly(9,9-dioctylfluorene)Conversion Study of Bromine-Magnesium Exchange Process During Grignard Metathesis Polymerization of Poly(9,9-dioctylfluorene)

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Poly(9,9-dioctylfluorene) (PFO) is an excellent material for use in organic light-emitting diodes (OLEDs) due to its flexibility and bright blue fluorescence properties. However, researchers face a challenge when synthesizing PFO, as controlling its molecular weight and polydispersity index (PDI) is difficult. Recent research suggests that chain-growth polymerization, where monomers are added one at a time onto an active site of a growing polymer chain, provides greater control over molecular weights and PDIs, resulting in well-controlled and high-quality polymers. The Grignard Metathesis (GRIM) Method is one commonly used chain-growth polymerization technique for synthesizing PFO, which involves three steps: (1) bromine-magnesium (Br-Mg) exchange reaction between the monomer 9,9-dicotyl-2,7-dibromofluorene (Br-FO-Br) and the Turbo Grignard reagent isopropylmagnesium chloride lithium chloride (iPrMgCl·LiCl), (2) subsequent addition of a Ni catalyst to initiate the polymerization, and (3) quenching to complete the polymerization. During the first step, the Br-Mg exchange reaction produces three products: monosubstituted, disubstituted, and unreacted monomers, which significantly influence the subsequent polymerization and the properties of the resulting polymer. However, the details of this step are unclear. To address this, we utilized Gas Chromatography-Mass Spectrometry (GC-MS) to study the conversion of the Br-Mg exchange reaction under different conditions, such as concentration, temperature, and time. The GC-MS results

provide insights into the conversion of monosubstituted, disubstituted, and unreacted monomers, facilitating the optimization of the synthesis process to yield higher-quality polymers.

(107)
Drug-induced Bradycardia Using 4D Light-Sheet Imaging in Zebrafish Larvae

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15-20% of all deaths worldwide come from cardiac arrhythmias (NIH Sudden Cardiac Death and Arrhythmias). Medication such as antiarrhythmic agents, antimicrobials, anticancer drugs, and psychotic drugs either will cause or aggravate a variance of arrhythmias. Drug-induced bradycardia, specifically, promotes calcium ion release at the base of the ventricles leading to action potential durations. The heart is built on specialized cardiomyocytes that form the cardiac conduction system that coordinates which part of our heart contracts. When the calcium ions in the cardiomyocytes are mishandled, it leads to pathophysiological conditions causing electrical conduction abnormalities and contractile dysfunction, ultimately leading to arrhythmias. Although we understand extraction-contraction coupling at the molecular and cellular levels, the spread of calcium ion transients in relation to the rhythmic contraction function across the entire atria and ventricle are rather nebulous. In this context, our objective is to unravel the cardiac conduction system and its connection to the rhythm of the heart. We aim to advance our understanding of the underlying mechanism of arrhythmias and facilitate the development of safer therapeutic options for patients. We have utilized zebrafish, which share analogous electrocardiograms with humans and similar cardiac growth, to study sinus and atrioventricular node dysfunctions that cause bradycardia. We have established a microinjection protocol for zebrafish larvae, including the introduction of small molecule compounds followed by imaging. We hope to be able to image the zebrafish and see if we can notice where in the heart it is having weak contractions.

(108)
The Effects of Short-Term Low-Dose Ethanol Exposure on Neuronal Activation in Discrete Brain Regions Implicated in Pain and DepressionThe Effects of Short-Term Low-Dose Ethanol Exposure on Neuronal Activation in Discrete Brain Regions Implicated in Pain and Depression

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Alcohol Use Disorder (AUD) is associated with pain and depressive-like symptoms affecting a significant portion of the population. Research has shown that brain regions such as the prefrontal cortex, amygdala, and hippocampus are implicated during chronic ethanol use. However, the specific changes preceding the development of AUD remain unclear. To investigate these changes, a low-dose, short-term ethanol exposure paradigm was chosen to determine which brain regions undergo neuronal activation before the induction of alcohol-related pathologies. Mice were subjected to a 5% ethanol diet for 14 days then underwent pain and behavior testing. To assess neuronal activation via cFos, an immediate early gene, we utilized a genetically modified inducible mouse model to tag activated neurons by injecting tamoxifen. After 7 days, brain tissue was collected and imaged. We hypothesize an increase in neuronal activation in the discrete brain regions following brief, low-dose ethanol exposure. Preliminary analysis of the brain images reveals elevated concentrations of activated neurons, particularly in the olfactory bulb, amygdala, and hippocampus. Among these regions, the hippocampus exhibits the most significant difference in cFos expression. These findings suggest that short-term low-dose ethanol exposure enhances neuronal activation mainly in the hippocampus. Further investigation and analysis will provide deeper insights into the effects of short-

term ethanol exposure on specific brain regions and contribute to understanding the neuronal changes implicated in AUD development.

(109)
Concurrent Matrix Multiplication In Multicore SystemsConcurrent Matrix Multiplication In Multicore Systems

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In today's world, we majorly rely on multithreading. It's used in a variety of ways, such as writing reports in Word with different fonts or playing games with shaders. Multithreading allows a program to break a task into smaller proportions and distribute the work so that the final product can be achieved more efficiently; it is similar to dividing and conquering.
In this project, we used multithreading to solve matrix multiplication. Matrix multiplication is heavily used in solving systems of linear equations, image processing, machine learning, etc., and is commonly used in fields such as engineering, physics, and cybersecurity. Matrix multiplication is taking the "dot product" of two matrices. This may seem simple, but when placed on a larger scale, one thread takes an excessive amount of time. Even though multithreading reduces the amount of time it takes to run the program, it is still too slow for larger-scale matrices.
Here, we attempt to take matrix multiplication a step further by using Strassen's Algorithm and running it with multiple threads. Strassen's Algorithm is a recursive program, meaning it can run inside of itself. This makes it challenging because certain steps must finish before moving on to the next. Our goal is to observe how the time to multiply matrices with Strassen's Algorithm compares to traditional matrix multiplication along with multithreading.

(110)
Learning Computing Knowledge Surrounding Software Tools: An Experience Report on Exploring ECSTATICLearning Computing Knowledge Surrounding Software Tools: An Experience Report on Exploring ECSTATIC

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Automated testing and debugging of static analyzers is a challenging task because these analyzers often implement advanced algorithms and take complex programs as inputs. ECSTATIC is the first tool to enable the automation of this crucial software maintenance and development process. During this research project, students analyzed the research paper "ECSTATIC: An Extensible Framework for Testing and Debugging Configurable Static Analysis" and learned to configure the systems utilized for running the ECSTATIC framework. This allowed them to develop an understanding of the principal concepts of static analysis, partial orders, configuration, and software bugs. Students then cloned the ECSTATIC tool from GitHub (a platform that allows for software development and collaboration), created a virtual environment, and built a Docker container to set up ECSTATIC. This was achieved by employing a secure shell and Microsoft Visual Studio Code over Linux and Macintosh operating systems. The software evaluation of ECSTATIC has been reinforced multiple times by the testing performed on popular Java/Android static analyzers: FlowDroid, SOOT, and DOOP. In order to experience ECSTATIC's evaluation, it was necessary for the students to improve their knowledge of multiple programming languages (Java, JavaScript, and Python). This overall experience demonstrates the feasibility of using a software tool as the basis of computer science education, where the students are exposed to software concepts and the novel tool ECSTATIC while learning the implications and impact of such tools in the real world.

(111)
Polyethylene Glycol Precipitation of Blunt Versus Sticky-ended DNA

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Eukaryotic DNA is compacted into nucleosomes, comprised of 147 bp of DNA wrapped around the histone octamer. The nucleosome acts as a regulatory mechanism, packing genetic information within cells and regulating access to DNA for functions such as replication, transcription, and DNA repair. Tri-nucleosome arrays can be a valuable model to study chromatin in vitro as they allow us to monitor the effect of nucleosome modifications in a chromatin-like environment. To assemble the tri-nucleosome array, we developed a DNA system that allows for precise ligation of three independently reconstituted nucleosomes. The DNA constructs contain the Widom-601 sequence with a high binding affinity for histones. DNA strands are ligated with T7 DNA ligase. Previously established protocols used polyethylene glycol 6000 (PEG6000) to purify the 147 bp Widom-601 insert from the large vector. Here, we investigate the ability of PEG6000 to precipitate sticky-ended DNA fragments compared to blunt-ended fragments. Minimal precipitation of sticky-ended DNA would make tri-nucleosome preparation more efficient. Plasmids were amplified in a laboratory strain of Escherichia coli and purified using an established protocol. Specific restriction endonucleases then made sticky- or blunt-ended fragments that were tested for precipitation with PEG6000 during vector removal. As expected, PEG6000 cleanly separated the vector and fragment for blunt-ended DNA. However, PEG6000 did not efficiently separate the vector and fragment with sticky ends. This result means that sticky ends must be produced by a second digestion after PEG6000 precipitation of the vector. Ligation of the constructs was subsequently optimized, and nucleosome reconstitution is being tested.

(112)
Weighted Peer Ranking Improves Evaluations of Large Language Models

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As large language models (LLMs) grow increasingly powerful, there is a need to evaluate their capabilities and performance effectively. Human evaluations are costly and time-consuming, so many recent studies instead use the perceived best LLM at their disposal to generate evaluations. However, this approach is prone to systematic biases such as self-enhancement and positional bias that undermine accuracy. We propose a novel method to combat these biases and improve accuracy. Using each model as a judge, we generate pairwise comparisons for each pair of model-generated answers to the same question. We then use the novel Peer Rank algorithm to combine the evaluations from all judges to induce a self-ranking on the models, giving higher weight to judges that demonstrate better performance according to the self-ranking. We conduct experiments on an enhanced version of the Vicuna dataset. We see that our Peer Rank method provides a significantly more accurate evaluation of models at both a global system-level and example-level. Our work thus provides a more accurate method for evaluating the performance of LLMs automatically and creates avenues for similar evaluation methodologies.

(113)
An Examination of Visceral Pain-Like Symptoms Across Ages, Sexes, and Bladder Injury.

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Urinary tract infections (UTIs) are the second most common bacterial infection, with aging populations being more susceptible. Around 25% of all geriatric hospitalizations are due to UTIs. And UTIs create

unique mental challenges for aging populations, such as anxiety and delirium. Research on the interaction between UTIs and delirium remains critical to address the clinical need. Our lab uses cyclophosphamide (CYP, a chemotherapy drug) to model bladder pain in mice. For this study, we aimed to determine if CYP could be used to model UTI symptoms in aged and young mice. We hypothesize that UTI symptoms (e.g., abdominal pain and delirium) will be more prevalent in aged adult mice (16 months) compared to young adult mice (2 months) when treated with CYP. Prior to CYP treatment, all mice underwent baseline behaviors. Abdominal and hind paw sensitivity was measured with the von Frey assay; anxiety was observed via open field and elevated plus maze. Next, we injected CYP (100mg/kg) three times over five days. Following injections, mice were re-tested for anxiety and mechanical sensitivity. Preliminary data reveals an overall increase in anxiety, which correlates with delirium symptoms, in aged female and aged male mice. Additionally, the aged population shows significant abdominal hypersensitivity but no change in hind paw sensitivity following CYP. Future project goals will measure neuronal activity and brain inflammation following CYP treatment. This data will ultimately give insight into the use of CYP as a model of UTI with or without delirium in rodents.

(114)
Surface Modified Dendrimers for the Slow Release of Active Ingredients

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Around the world the demand for skincare products containing active ingredients such as retinol and hyaluronic acid are growing in popularity due to the benefits they provide for the skin. However, in current formulations, the active ingredients are delivered immediately upon application to the skin. This is problematic because this can cause local skin irritation and peeling of the stratum corneum, which is the body's primary defense mechanism against toxins from the outside world. To combat these adverse effects, our proposed solution is the extended-release delivery of active ingredients using nanoparticles, thereby preventing skin irritation, and allowing for maximum efficacy of the product. This project aims to synthesize a nanocarrier system that will allow for the extended release of retinol, in skincare products. The proposed design is to combine a G4-PAMAM dendrimer, polyoxazoline, and a peptide of choice. This will be accomplished through a multi-step synthetic scheme utilizing multiple spectroscopic techniques to confirm the synthesis of the system. The G4-PAMAM dendrimer will be used to encapsulate and deliver retinol. Polyoxazoline will be used as the linker molecule to improve the solubility of the G4-PAMAM dendrimer, which is a challenge of using the dendrimer alone. Lastly, palmitoyl pentapeptide-4 will be coupled to the system. This peptide promotes collagen and elastin production in the skin. The nanocarrier system has been successfully synthesized and release studies are currently being conducted. Collagen/elastin stimulation assays, and skin permeation tests will be conducted to measure the effectiveness of the synthesized system in the future.

(115)
Quantifying the Effect of Gaussian Noise on Bayesian Optimization Performance

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Bayesian optimization (BO) is commonly used for designing efficient experiments which maximize (or minimize) a real-world function without requiring function type or gradient information. Many previous studies which evaluate BO with different underlying models, batch picking methods, or acquisition policies use synthetic functions (that is, functions whose closed form is known) without any noise. Since experimental results naturally contain noise, this study aims to quantitatively evaluate the effect of noise on the model's performance. In this study we benchmark the change in performance of batch

BO by adding randomly generated Gaussian noise to two representative synthetic functions: the six-dimensional Ackley and Hartmann functions. We use batch BO because often in an experimental setting it is practical to take several measurements at once to save time and materials. Our study compares the effect of varying noise levels on the Gaussian regression model using different acquisition policies (Expected Improvement and Upper Confidence Bound), which balance between exploring the input space and exploiting the model by sampling near the currently known optimum. We also test different batch picking methods (Local Penalization, Constant Liar, and Kriging Believer), which determine how a batch of input points is selected to be sampled. Our results enable more accurate predictions for convergence conditions of batch BO given the noise level.

(116)
Infant-Directed Speech in Bilingual (English & Spanish Speaking) Children

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Infant-directed speech (IDS) is a type of speech adaptation produced by adults when speaking with young children. IDS is ambiguous, with some definitions based on acoustic characteristics including exaggerated pitch range, sing-songy intonation, and slower speaking rate. Contrarily, others define IDS based on speech directionality towards young children, irrespective of acoustic characteristics. Previous work has consistently proven IDS facilitates young children's language development. However, it remains unclear whether the active ingredient in IDS is its unique prosodic features or its directive nature. This study aims to describe the different types of IDS that Spanish-English bilingual toddlers (21 – 30 months) hear in their natural language environment using all-day home language recordings. For each participant, we randomly selected eight 5-min segments and coded adult utterances based on (a) language (Spanish, English, mixed); (b) speech register based on prosody (infant register or adult register); and (c) directionality (directed to the child, not directed to the child). Three home language samples from bilingual children have been coded. Preliminary findings suggest that prosodic characteristics and directionality of IDS operate independently: bilingual toddlers are exposed to speech directed to the child in infant register, speech directed to the child in adult register, speech not directed to the child in infant register, and speech not directed to the child in adult register. Understanding the types of IDS bilingual children hear is a first step in enhancing language development and intervention in this population. Our future direction involves exploring various IDS types and their impact on bilingual children's vocabulary development.

(117)
Diminished Quality of Life in Afghanistan

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The end of US military intervention and the intervening rise of the New Taliban have deteriorated humanitarian conditions in Afghanistan, affecting millions in country. However, the psychosocial impact on Afghani citizens is not well understood. This research is meant to capture the experiences, physical and psychosocial impacts on Afghan adults (ages 18 to 65 years old) living through the 2021-23 humanitarian crisis in their homeland. Using mixed methods, this study aims to examine the coping mechanisms and extent of psychosocial stressors on the Afghani population. With an anonymous semi-structured survey for residents currently living in Afghanistan since the US military withdrawal, snowball sampling will be applied. Past research informs a three-tiered hypothesis: (1) due to the decades-long conflict, the majority of Afghans have PTSD, depression, or anxiety due to contact with combat; (2) notable gender disparities, with Afghan women having a higher probability of mental illness due to stigmatization and lower access to care exist; (3) Afghani nationals use an

emphasis on religious activities for coping with stress and support from family and friends. Our findings will build upon these hypotheses, with several novel questions to understand the mechanism of coping. For instance, an inclusion of qualitative descriptions of governmental support under the New Taliban, as it correlates to psychosocial stressors. The study aims to inform the psychosocial stressors the Afghani people face after compounding traumas and support interventional strategies on civilians from their perspective.

(118)
Synthesis and Analysis of Photochromic Bicyclic Aziridine to Implement into Organic Field Effect Transistors

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Photochromic compounds are a group of compounds that can change their conformational structures under the presence of specific wavelengths of light. This structural change results in a shift in dipole moments, altering the compound's property. Bicyclic aziridines are a class of photochromic compounds can undergo this phenomenon, where they "open" up under UV light and "close" back to its original conformation under visible light. The "open" state has a greater dipole than its original "closed" state, which can be explained by the creation of formal charges from the photolyzed carbon-carbon bond under UV light. Such characteristic can be implemented to organic semiconductors to act as a non-contact switch for devices such as organic field-effect transistors (OFETs). There have been studies about how other photochromic materials such as diarylethenes perform in OFETs. However, not much is known about bicyclic aziridine compounds. This research aims to investigate the absorbance of UV light of two bicyclic aziridine compounds (M1 and M2) by looking at the wavelength of the maximum absorbance in solution and in solid-state. It was determined that the maximum absorbance of M1 in its "open" state was 448 nm in solution and 630 nm in solid-state. For M2, the maximum absorbance in its "open" state was 441 nm in solution and 611 nm in solid-state. From this, we can use the data to proceed with further research by implementing these structures into conjugated organic compounds and investigating their effects on charge mobility in both states in an OFET device.

(119)
Differentiating Prosodic Properties from Directionality in Infant-Directed Speech

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Infant-Directed Speech (IDS) is broadly defined as a speech adaptation used by adults when speaking to young children. There is uncertainty in research on the specific characteristics that are attributed to IDS. IDS is sometimes defined with emphasis on acoustic properties such as exaggerated pitch, melodic tones, and a slow speaking rate. Other times, it is used to simply refer to directing speech at a child, with no mention of prosody. Existing research has shown that IDS aids in language development in children, but knowing which is the true facilitator of language development in IDS: acoustic or directionality, remains ambiguous. This study seeks to differentiating the types of IDS that English monolingual toddlers (21-30 months) hear in their home. We randomly selected eight 5-minute segments from each participant and coded utterances based on (a) the speaker (mother/father/etc.), (b) the speech register based on acoustic properties (infant/adult register), and (c) directionality (directed to child/not directed to child). I have coded samples from 4 toddlers and am coding samples from 1 more child. Preliminary findings suggest that the two characteristics operate independently; English monolingual toddlers hear speech directed and not directed to them in both infant and adult registers. The final poster will include data from 5 children total. Understanding the

types of IDS on young children will allow for researchers, clinicians, and families to better their language development and intervention techniques. In the future, we will continue to explore the effects of each type on language development.

(120)
Understanding the Psychosocial Needs of Acid Attack Survivors Globally

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Acid attacks are a heinous form of interpersonal violence that affects millions globally, disproportionately impacting women and girls in developing countries. While preliminary research brings awareness to the issue of acid attacks, the psychosocial needs of acid attack victims are still not well understood. Our study intends to capture the psychosocial needs of acid attack victims to improve their rehabilitation, re-entrance into society, and quality of life post-attack. In further phases of this study, global differences will be analyzed to inform regional policies and rehabilitative programs. This study will qualitatively examine the psychosocial needs and experiences of victims primarily through a semi-anonymous survey. Through partnership with The Center for Rehabilitation of Survivors of Acid and Burns Violence (CERESAV), the survey will be initially administered to victims in Uganda, a region with high prevalence of acid violence. This survey aims to collect data on the psychosocial effects of acid attacks, including, but not limited to, low self-esteem, depression, post-traumatic stress disorder (PTSD), and social isolation. This data will be analyzed to identify common factors that promote resiliency and rehabilitation. Past research informs a multipronged hypothesis: (1) due to the debilitating and life-altering nature of acid burns, social isolation and stigmatization is one of the primary causes of psychological distress in victims; (2) gender disparities largely impact the rehabilitation process and quality of life post-attack; (3) an emphasis on increasing access to formal support services is needed to improve the psychosocial wellbeing of victims. Our findings will likely build upon this hypothesis.

(121)
Efficient Presentation of Soil Health Parameters from Electrochemical Sensors to Users

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Soil is a complex ecosystem and habitat for numerous families of organisms, captures and stores large reserves of carbon, and, critically, provides an anchor for roots and nutrients for healthy plant growth. To assess soil health and capacity for plant growth, parameters like pH, nitrate, phosphorus, and moisture levels must be collectively analyzed throughout the planting season. Current procedures to do so require a soil sample to be removed from the site and treated at a lab before measuring. This process is costly, takes a significant amount of time, and only provides discrete measurements, rather than a continuous real-time monitor. In contrast, this work utilizes electrochemical sensors that use a screen-printed electrode system to monitor soil health parameters. At present, this data is stored on an SD card via an Arduino connected to a potentiostat. This work aims to further develop the necessary firmware for these sensors to present this data to users via a mobile application. This process requires several moving components: a Bluetooth Low Energy connection between the Arduino and application that allows for data to be transferred from the Arduino's SD card to the application's local files, a set of Matlab macros that convert the raw data into intelligible concentration values for each parameter, and a graph system that can track these concentrations over time to present to users. The mobile application can thus communicate with each soil probe to obtain its data, giving users a comprehensive view of their soil health in different locations.

(122)
Incorporating a Multiplexer to Facilitate Fast Testing of Solar Cells

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Perovskite solar cells (PSCs) have achieved competitive power conversion efficiencies in recent years and continue showing potential for higher performance. To improve the performance of PSCs, we need to make many devices and perform current density – voltage (J–V) measurements under simulated solar light. However, our existing J–V setup utilizes a sample holder that can only hold one sample at a time. Additionally, the 1-sample holder is awkward to operate in the glovebox, and its pogo pins regularly scratch the samples. We seek to replace the 1-sample holder with an updated sample holder that can hold four samples at a time and has a built-in silicon reference cell to monitor the light intensity. Incorporating the 4-sample holder into our J–V setup requires three additional hardware pieces: a Keysight multiplexer and two 20-channel plug-in cards that need to be wired to the 4-sample holder. We also have to write Python codes to direct the multiplexer to open and close the channels on the plug-in cards, control the Keithley source meter, and trigger the voltage sweep while measuring the current. We find that with these modifications to our J–V setup, less handling of the samples is required, so the devices are less likely to be damaged. The new J–V setup will help speed up the testing of PSCs, saving time and enabling faster progress as we strive to optimize the performance of PSCs.

(123)
Optimization of PhotoThermal Therapy for Enhanced Immunogenic Cell Death

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Photothermal therapy (PTT) is a non-invasive and promising new cancer therapeutic for shallow, solid tumors—e.g., breast and melanoma. It utilizes tissue-penetrating, near-infrared (NIR) light to locally heat a tumor site in the presence of a photothermal agent (PTA). Effective PTAs convert NIR light into heat with high photothermal efficiency through strong absorption within the NIR spectrum and low fluorescence quantum yield. PTT is an attractive therapeutic for immunogenically “cold” tumors and elicits immunogenic cell death (ICD)—which is achieved through the production of damage associated molecular patterns (DAMPs). DAMPs are expressed by dying cells that provoke a pro-inflammatory immune response. To optimize the photothermal parameters of a self-adjuvanting viral PTA, PhotoPhage, we extensively studied its ICD abilities in triple negative breast cancer (TNBC). PhotoPhage was synthesized through the bioconjugation of NIR-absorbing croconium dye onto bacteriophage Qß. The photothermal parameters of PhotoPhage-mediated PTT for enhanced ICD were optimized and the adjuvanting properties of PhotoPhage was studied. Mild heating, 50–60ºC was established to be optimal for achieving TNBC apoptosis and allows for the greatest expression of surface-exposed DAMPs. Additionally, the secretion of pro- and anti-inflammatory cytokines was investigated when presented with PT-treated TNBCs. This photothermal optimization allows us to not only study the “cold” to “hot” tumor conversion, but also ensures that we utilize PTT- mediated ICD to the maximum of its therapeutic ability.

(124)
Breaking the Chain: Engineered VLPs As Targeted Allies Against Metastatic Tumor Cells

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Virus-Like Particles (VLPs) are nanoparticles that mimic a virus but do not contain the viral genome. They can be modified on the interior and exterior, to be used to encapsulate or deliver desired drugs making themselves useful candidates for cancer immunotherapy. Metastatic tumor cells are a common complication within developing cancers. Cancer cells' rapid increase could be credited to PLK1 overexpression. Silencing the PLK1 gene can be accomplished using SiRNAs, however, this strategy is often associated with toxicity and poor stability and uptake. Some of these tumor cells are overly expressed with human epidermal growth factor receptor-2 (HER2) receptors that can lead to increased signaling through the HER 2 pathway causing uncontrolled cell growth and division. Using a VLP called Bacteriophage Q, these tumor cells can be easily targeted by expressing an affibody to target HER2+ receptors within their own coat proteins. This QBeta can be used to silence mutation as well, causing genes within tumor cells to prevent development and progression by using targeted SiRNAs within the interior making this quite an effective treatment. Using this engineered VLP could provide an efficient way of silencing the PLK1 gene and no toxic effects, making this treatment safe and affordable.

(125)
Optimizing Purification of DNA-binding Protein MBD3 in Escherichia Coli

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MBD3 (Methyl-CpG binding domain protein 3) is a part of the NuRD (Nucleosome Remodeling and Deacetylase) complex, which fine-tunes gene expression through its interactions with chromatin. By recognizing unmethylated, methylated, and hydroxylated DNA, MBD3 targets the NuRD complex to gene promoters. While its DNA-binding MBD domain is structured, 76% of MBD3 is intrinsically disordered. To provide large quantities of high-quality, pure protein for biochemical experiments, we aimed to optimize the expression and purification of full-length, human MBD3 in a recombinant bacterial system. The MBD3 gene was not optimized for bacterial expression, as the sequence includes rare codons suspected to cause low protein yields. MBD3 was expressed in two Escherichia coli strains, BL21(DE3) [BD] and Rosetta II(DE3)pLysS [RSII]. The latter strain has exogenous genes for the expression of tRNAs for rare codons. Expression in RSII was performed at 16°C for 18 h, while the expression in BD was performed at 37°C for 2 h. Cells were harvested and purified through a multistep scheme with nickel affinity and anion exchange chromatography, after which pooled fractions were flash-frozen with 10 percent glycerol. Samples were thawed and the final size-exclusion chromatography step was performed. No protein was recovered, indicating that MBD3 was unable to enter the column. To investigate this, we performed a time course analysis of MBD3 from other preparations that did not include the flash-freezing step prior to SEC. Our results suggest that MBD3 is unstable and prone to aggregation and cannot withstand the stress of freeze-thawing commonly used for protein storage.

(126)
The effects of dual-task on sit-to-walk performance in healthy young adults

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Cognitive dual task (DT) is crucial to understanding the relationship between neurological and motor functions, as it has been linked to unstable gait performance in individuals. Poor gait in elderly populations can impede their ability to execute everyday transitional movements, such as going from a sitting to walking (STW) state, which increases the chance of fall-risk. Limited literature examines

how DT affects STW initiation. The purpose of this study is to investigate the effects of cognitive DT on STW characteristics, namely STW phase duration, hesitation, peak center of mass (COM) velocities, and initial step length in STW performance among healthy adults. Focusing on a healthy young population may help deduce baseline demographic information that can assist future studies. Participants (n=12) aged from 18-44 performed 3 single task (ST) and 3 dual task timed-up-and-go trials. Data was collected using 100 Hz 3D motion capture technology (VICON) and 100 Hz force plates (Kistler). Preliminary results show that compared to ST, in DT the total STW phase duration was 0.24 seconds longer and the hesitation ratio increased by 25%. The peak sagittal COM velocity increased by 19% in DT. The initial step length was negligible. From the data collected, we concluded that DT activity led to decreased quality of STW gait characteristics. These findings will further validate previous studies and serve as comparative data that examines how neurological diseases can impact movement stability.

(127)
The Effects of Chitosan Source on the Mechanical Properties of 3D Printed Polymer Composites

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Chitosan, or deacetylated chitin, is a linear polysaccharide composed of glucosamine and N-acetyl glucosamine units. Chitin is found in the cell walls of crustaceans, fungi, and insects, making chitosan the second most abundant natural polymer on earth. The broad availability of chitosan makes it an attractive material for applications in the textile, medical, and agricultural industries as well as for use in environmental waste remediation. Additive manufacturing, or 3D printing, is a technique that can be used to produce polymeric materials on demand, based on custom digital designs. In order to make plastics that 3D printers use more environmentally friendly; we aim to use chitosan-based additives to replace petroleum-sources. Using a digital light projection (DLP) 3D printer, we incorporated chitosan from different sources into the photoresins. We explored how the source of the chitosan (fungal vs. Crustacean) can affect the mechanical properties, resin incorporation, and printability of the photoresin. The 3D printed materials were tested to compare the mechanical properties of the polymers with chitosan from different sources and loadings. Higher loadings of chitosan improved the strength of the printed materials, creating materials with bio-based content that can be utilized for various applications. Preliminary results show that chitosan with higher loading and higher molecular weights improved the mechanical properties. However, the source of the chitosan affected the incorporation and printability of the photoresins. The nature of the relationship between the chemical structure of the chitosan and its ability to blend with photoresin monomers will be the subject of continued investigation.

(128)
Optimization and characterization of a Donor-Acceptor-Donor type molecule for applications in Organic Field Effect Transistors

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Organic Field Effect Transistors (OFETs) are a class of electronic devices used to control the flow of current. OFETs are sandwiched-structures fabricated by depositing materials layer by layer, each with its role in the device. This technology was first reported in the late 1980s with low performance, which has since been improved. However, their properties are still far from silicon monocrystal-based devices. The easy property tuning, flexibility, low weight, cheap preparation methods, and low processing cost are attractive prospects for becoming widespread in the near future with possible applications in soft materials engineering, portable and flexible devices.

This work was divided into two sections: first being the optimization of the synthesis of a donor-acceptor-donor active layer based on thiophene-flanked diketopyrrolopyrrole (Th-DPP) as the central acceptor and thieno[3,2-b]pyrrole (TP) as the donor; the second being the fabrication and characterization of bottom-gate/bottom-contact type OFET architecture.
The synthesized molecules were characterized by Nuclear Magnetic Resonance (NMR) to confirm the chemical structure, Gas Chromatography-Mass Spectrometry (GC-MS) to investigate the molecular weight, UV-Visible Spectrophotometry (UV-Vis) to identify the absorption spectra, and Cyclic Voltammetry (CV) to compare the band gap values between the thin film and solution. Lastly, tapping mode Atomic Force Microscopy (AFM) was for surface characterization of the films annealed at various temperatures while the OFET performances were investigated for turn-on voltages and charge mobility. The results show promising performances at the annealing temperature of 80°C, with charge mobility of 6e-3 cm2/V/s and surface roughness of 2.5 nm.

(129)
Crystallization of a Novel Manganese Coordination Polymers

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Manganese based materials have many potential uses including batteries, catalysis, biosensors, and as antimicrobials . Recently they have gained traction in biomedical applications such as potential MRI agents and in immunotherapy. The study of novel biofriendly manganese coordination polymers would unlock new possibilities to use manganese in more applications. Using previously established MOFs as our blueprint, we have found that a combination of manganese, sodium ascorbate, and 2-methylimidazole will generate a stable manganese compound that could potentially be of use in the aforementioned fields. From here our goal was to identify the molecular structure of this compound and its potential uses. To do this, the traditional approach of single crystal structure analysis was employed. Using vapor diffusion, we grew a pure phase single crystal large enough to examine by single crystal X-ray diffraction. With the parameters of the original unknown crystal found, it was then possible from there to cross reference with the public crystal database (CCDC) and confirm novelty. Additionally, it's notable that by changing stoichiometric ratios, crystals formed different morphologies. While the original crystal was cubed, other ratios resulted in bladed and needle like crystals. Further characterization is being carried out on powder samples while additional testing is performed on the potential applications for this material.

(130)
Can Green's Functions Be Used to Study The Riemann Hypothesis? An Investigation

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The Riemann zeta function has applications in various fields of mathematics and physics. The Riemann hypothesis states that the only zeros of the Riemann zeta function are the negative even integers and complex numbers with real part ½. Prior research by Bender, Brody, and Müller has shown that the zeros of the Riemann zeta function are closely related to the eigenvalues of a specific Hamiltonian operator. If the eigenvalues of this Hamiltonian are real, the Riemann hypothesis is true. We use Green's functions to find the eigenvalues of another well-known Hamiltonian. Green's functions are used in mathematical physics and can be used to explore various properties of Hamiltonians, such as their eigenvalues. Our research suggests that Green's functions could be used to investigate the Hamiltonian defined by Bender, Brody, and Müller, and could possibly reveal more information about its eigenvalues.

(131)
An Open-Source Matlab-based Compression Algorithm for People with Hearing Loss

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As per WHO and NIH, about 432 million adults (37.5 million in the US) have disabling hearing loss. People with hearing impairment (PHI) can benefit from hearing aid devices (HADs), helping them to be more active in daily life. One crucial reason noted for the low usage of HADs by PHI is the accessibility and affordability of the HADs. Smartphones and tablets have recently become valuable devices due to their availability, powerful built-in processors, and ease-of-intractability. In this project, we analyze an open-source multichannel dynamic range compression (COMP) algorithm, an indispensable component of the signal processing pipeline for the hearing aid application. It provides optimal fitting of received incoming signals by adjusting the frequency-dependent gain function according to the individual's hearing sensitivity levels. This work examines how the COMP algorithm automatically adjusts the gains at six-octave band frequencies (125, 250, 500, 1000, 2000, and 4000 Hz) for optimal speech intelligibility and comfort for PHI. This open-source algorithm can then be converted to C/C++ and installed on smartphones or tablets to run as a real-time application. It can be used by researchers, audiologists, engineers, educators, and students to study, explore, and develop new ideas and methods for improving the monaural and binaural hearing aid applications for PHI. The results of this project will be reported regularly, leading to the publication of technical papers and presentations in appropriate journals or conferences.

(132)
Detecting Transposable Elements Using Chimeric Reads

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Transposable elements (TEs) are repeat regions of the genome which can transpose from one location to another by either a “copy-and-paste” mechanism (retrotransposons) or a “cut-and-paste” mechanism (DNA transposons). Retrotransposons represent the majority of TEs in the human genome and are its only active TEs. Previous research has shown retrotransposons to be connected to many diseases and disorders such as glioblastoma or PTSD. Various bioinformatics pipelines exist to detect TEs but lack portability and reproducibility. Using the nf-core framework, we are developing a pipeline to detect TEs using a chimeric read approach based on the workflow of nf-core/viralintegration. A chimeric read approach identifies contiguous segments of reads that align to two different and distant segments of the reference genome. We are working to detect TEs from human endogenous chimers where a known transposable sequence interrupts the reference genome. To accomplish this, we created a dataset of commonly active TEs in humans, which includes Alu, SVA, HERV, and L1. The L1.4 sample carries the code for the proteins which promote transposition of Alu, SVA, and L1 TEs. Utilizing this test data, the existing nf-core/viralintegration pipeline was modified and debugged to successfully detect TEs. The optimization of pipeline parameters for the detection of chimeric reads is an ongoing process. We aim to create a set of simulated reads that can be used as a benchmark for the presence of active transposition.

(133)
Exploiting Background Knowledge and Implicit Messages for Hateful Meme Detection

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Detecting prevalent hateful memes on social media is a critical task for preventing targeted attacks against individuals or groups based on their characteristics. However, automatic hateful meme detection poses significant challenges due to the inherent multimodal nature of memes, encompassing both images and text. These components often diverge to create a greater impact or irony, necessitating a comprehensive analysis of the image-text relationship rather than treating these elements independently. Contextual background knowledge, which includes common sense, factual information, and situational understanding, plays a pivotal role in this process. However, even for humans, recalling such extensive background knowledge for every meme is a daunting task. Addressing this challenge, we propose the use of large language models (LLMs) to enhance hateful meme detection by generating the requisite background knowledge and deciphering the implicit messages conveyed by the meme creator. Through these implicit messages, it enables differentiation between the author's use of a meme as an online communication tool or as a medium of hate expression. Our results on Hateful Meme datasets demonstrate the effectiveness of our reasoning approach, providing a viable solution for the task of hate meme detection.

(134)
A Paradigm Shift in Software Security Analysis: Exploring the Potential of Large Language Models

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Software security analysis is essential in identifying, assessing, and mitigating code vulnerabilities and is used by various stakeholders involved in software development and security assurance. CVEs (Common Vulnerabilities and Exposures) and CWEs (Common Weakness Enumerations) facilitate a standardized way to document vulnerabilities and weaknesses, as well as their detection, mitigation, prevention, associated CVSS (Common Vulnerability Scoring System) score, and source code. Such widely used tools are based on static and dynamic analysis methodologies with limitations in code coverage, contextual understanding, and performance/development overhead. Our goal is to explore the abilities of ML, deep learning, and AI methodologies in performing software security analysis tasks, including partial code analysis, software weakness (CWE) classification, vulnerability score (CVSS) prediction, and vulnerability explainability, compared to conventional static and dynamic analyses. Off-the-shelf, today's top LLMs are capable of surface-level code analysis, but not to the granularity required of more complex vulnerabilities. However, preliminary results show that code analysis prompts in GPT-4 and Claude-2, when contextualized with relevant CVE and CWE data, produce an analysis report of unprecedented granularity, contextual understanding, and vulnerability assessment. We formed BigVul++, a dataset of open-source CVEs that contained CVE data, associated code changes, vulnerable code, and CWE data. Future experiments will run various configurations of prompts and BigVul++ data across various LLMs to perform the above software security analysis tasks, and if statistically significant, may signify major improvements in performance, useability, and explainability over static and dynamic analyses.

(135)
Austin Chalk: Foundation of UTD

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The Austin Chalk is what UTD and the cities of Dallas, Richardson, and Plano are built on. It is what geologists call a "formation", named after the city of Austin where it was first described. The Austin Chalk is a type of limestone that was deposited during the Late Cretaceous Epoch, about 90 to 83

million years ago when all of Texas was a shallow sea. The Austin Chalk consists of predominantly interbedded grey-white chalk and marl and is about 120 m thick in the DFW region. I studied samples from UTD construction sites to understand what it is composed of. Samples were collected from three excavations: the Science Learning Center, Hoblitzelle Hall, and Waterview Parkway. The Austin Chalk is composed mainly of the remains of marine single-celled plankton, including zooplankton (esp. foraminifera) and phytoplankton (coccolithophores and other calcareous algae). These microscopic organisms built shells of CaCO3 (calcite), which settled to the bottom of the sea after the organism died. The foraminifera ate the photosynthetic nannofossils (coccoliths and algae) and other creatures ate the forams. Foraminifera microfossils are intact (100 to 1000 microns) whereas coccoliths occur as small (20-micron) discs that separated when the single-celled organism died. The small size of these nano- and micro-fossils required using the Geosciences scanning electron microscope (SEM) to study them. The sample of Austin Chalk we studied contained 90% nanofossils, 8% forams, and bivalve calcareous fragments and 2% insoluble (non-calcareous) material.

(136)
Physically Secure Hardware Redaction and Logic Locking with Hybrid Systems

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Logic locking and hardware redaction are logic design methodologies used to hide functionality and secure chips against malicious actors by corrupting the output of the chip if it is not programmed correctly after fabrication. Attackers may have access to a chip's structure, but without the correct key bitstream, the functionality of the chip will remain obfuscated. Therefore, security of the chip hinges on the security of the key bitstream, which may be vulnerable to algorithmic and physical attacks. While there have been many successful studies toward securing the key against algorithmic attacks, it was recently demonstrated that any on-chip keys stored and/or used electrically are vulnerable to electrical imaging and other physical attacks. If a chip is not secure against physical attacks, it is not secure at all, regardless of its security against algorithmic attacks. To provide security against physical attacks, physically secure circuits have been proposed with emerging device technologies that are not vulnerable to electrical imaging. The switching error rates of these emerging technologies, however, are too high for large-scale integration, limiting the size of circuits that can be secured against physical attacks. In a previous work, we conceptually proposed the use of multiple islands of physically secure emerging technology circuits within a large-scale CMOS system. We demonstrate here
that this hybrid approach for physical security also provides algorithmic security.

(137)
Between Liberation and Murder: The Lives of Seven Men in the Final Year of the War

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After the landing of the Allied forces on the beaches of Normandy, the Nazis' dawning realization of impending failure affected their increasingly panicked approach to deportations and existing prisoners' utility. WWII following D-day is understood as the beginning of the gradual, upward movement toward Europe's liberation, many concentration camps continued operations into the spring of 1945, and the Nazis continued to deport and murder thousands. My research sought to understand individual experiences within the war's final year through a digital humanities approach, specifically that of seven French Resistance fighters deported to Dachau in July of 1944. The

magnified focus of individuals' microhistories as well as the use of digital archives and interactive, quantitative visualizations not only contributes to the humanization of the millions murdered by the Reich, but also presents these stories in a way that is adaptive to increasingly digitized means of teaching and learning. By tracking the seven men through the Arolsen archive of Nazi prison logs and the French Ministry of the Armies's Mèmoire des Hommes archive of French Resistance documents, I outlined the events of these men's arrest, collective internment, imprisonment, and eventual murder within the context of the Nazi's hasty decisions pertaining to prisoners within arms' reach of Allied liberation. Their murder contrasted with the overall year of the Reich's gradual defeat exemplifies the singularity of individual experiences within the Holocaust and the precariousness of liberation.

(138)
The Gauss-Bonnet Formula for Four-Manifolds With Corners Of Codimension Three and Four

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The Gauss-Bonnet formula is one of the most important links between the fields of differential geometry and topology. Originally limited to two dimensions, the formula has been generalized to higher dimensions, but the great complexity of the resulting formulae makes geometric interpretation a challenge. In four-dimensions, the Chern-Gauss-Bonnet theorem has been rewritten in terms of quantities with good conformal transformation properties, which has allowed it to become a useful tool in conformal geometry – the branch of differential geometry that studies spaces where angles, but not lengths, are defined. This project extends previous work on this to the case of four-manifolds with corners of codimension three or four. The terms of the formula on a boundary component, as well as for the intersection of two boundary components, are already known. We find the boundary terms in the final cases: the intersection of three boundary components along a curve and of four boundary components at a point. We also analyze the conformal transformation of the resulting integrands. Thus, the Chern-Gauss-Bonnet formula has been fully adapted for the study of conformal metrics on four-manifolds with corner.

(139)
Redefining Accessibility: An Empirical Analysis on the UI/UX Issues of Mobile Applications

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Mobile accessibility ensures that individuals with disabilities can effectively use and engage with mobile applications. Current accessibility measures often remain inconvenient for users with disabilities. For instance, while existing features can read the content descriptions of UI components, they often lack the ability to provide interactive feedback or perform actions in response, hindering a seamless user experience and hampering their ability to perform tasks independently. To bridge the gap, we propose a framework that can provide interactive feedback between users and applications. Our project mainly includes two parts of efforts: (1) we create a dataset that includes UI screenshots and layout information of the most popular apps from various categories; (2) we modify the Contrastive Language-Image Pre-training (CLIP) model to improve UI/UX design and accessibility for users with diverse needs and enhance mobile accessibility. For the former, we utilize APE, a fully automated model-based testing tool, to generate screenshots of various apps at different screen states as well as the corresponding layout information, e.g., UI hierarchy and element attributes. For the latter, we leverage the CLIP algorithm, a pre-trained model capable of cross-modal understanding, as a reference to analyze the XML files in conjunction with textual descriptions, aiming to identify accessibility barriers and areas for improvement. CLIP's focus on its output is classification,

however, given that was not the output we intended, we looked towards modifying the algorithm to better suit our task.

(140)
Optimizing 3D Object Detection for Robot Imitation and Task Guidance using Computer Vision

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A three-dimensional object includes X, Y, and Z coordinates, each needing to have its location translated. In addition to the coordinate, the three-dimensional object needs to have its orientation and shape translated in real-time. This research focuses on optimizing 3D object detection using computer vision techniques, such as a Multimodal VoxelNet, Point Cloud, and the Hungarian Algorithm. By leveraging advanced algorithms and deep learning models, the aim is to improve the accuracy and efficiency of object detection in complex 3D environments and use it to solve downstream problems such as providing task guidance to humans (e.g., help them follow a cooking recipe) and having a robot imitate a set of actions performed by a human (e.g., transferring 100mL of water from a measuring cup to a vessel).

VoxelNet is an approach that combines 3D convolutional neural networks (CNNs) with point clouds. By dividing the point cloud into small volumetric units called voxels, VoxelNet enables CNNs to effectively process and analyze spatial information, leading to improved object detection accuracy. The Hungarian Algorithm, also known as the Kuhn-Munkres Algorithm, is a combinatorial optimization algorithm that was created to solve data association problems, which are a fundamental challenge in multi-object tracking.

Combining VoxelNet and the Hungarian Algorithm, this research aims to optimize 3D object detection by improving the accuracy of detecting objects, accurately analyzing their dynamic position and orientation. By leveraging advanced algorithms and deep learning models, the proposed approach seeks to address the challenges associated with real-time 3D object detection.

(141)
vGPCR Stimulates Interferon-Stimulated Gene Expression in HeLa Cells

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Kaposi's sarcoma-associated herpesvirus (KSHV) causes Kaposi's sarcoma, a cancer of the endothelial cells in the skin, lymph nodes, or mouth. Infection is widespread in sub-saharan Africa and the Mediterranean and among AIDS patients. Our research focuses on how KSHV activates the innate immune response in KSHV-infected cells and bystander cells (non-infected cells nearby infected cells). A previous graduate student from our lab produced preliminary evidence for this project. We hypothesize that the viral G-protein coupled receptor (vGPCR) is responsible for activating the innate immune response in KSHV-infected and bystander cells via paracrine signaling. To test this, I transfected HeLa cells with an empty vector control or an expression plasmid for vGPCR. Using RT-qPCR, I shall measure cells 1) with and without vGPCR and 2) with and without media from vGPCR-expressing cells for expression of specific interferon-stimulated genes (ISGs). Cells commonly express ISGs in response to viral infection. We expect to find that cells that express vGPCR have elevated levels of ISG expression compared to cells that do not express vGPCR. We also expect to find that, when treated with media from vGPCR-expressing cells, HeLa cells express

ISGs at elevated levels. This would imply that the innate immune response in human cells against KSHV is facilitated by the vGPCR.

(142)
Automatic Propaganda Processing

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Various propaganda techniques are used to manipulate peoples perspectives in order to foster an agenda. The purpose of this project is to create an AI model that could identify the message in memes, images including text, so that the spread of propaganda can be better understood. The data sets used in this project came from another research project titled SemEval-2021 Task 6: Detection of Persuasion Techniques in Texts and Images, in which 1000 memes were compiled meeting the requirements of image, text, and political references. I manually annotated each meme with the surface, background, and hidden messages I compiled and used the surface messages and the background messages to train a model to generate the hidden messages. The results of this project will be a large language model that generates a single sentence describing what the hidden message of the meme is.

(143)
Synthesis and Magnetic Study of Gadolinium Based Metal-Organic Frameworks

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Two new Gadolinium (Gd) based metal-organic frameworks (MOFs) were synthesized using bicinchoninic acid (BCA) as a linker. These MOFs have two distinct metal centers, a binuclear center to make two-dimensional MOF (Gd-BCA-2D) and a hexanuclear cluster to make three-dimensional MOF (Gd-BCA-3D). It is found that the use of fluorine-based modulators such as 2-fluorobenzoic acid, 2,6-difluorobenzoic acid, and perfluorohexanoic acid makes μ3-F bridged hexaclusters which drives the formation of a porous 3D framework in Gd-BCA-3D. These MOFs are characterized using X-ray diffraction (XRD), X-ray photoelectron spectroscopy (XPS), Thermogravimetric analysis (TGA), IR spectroscopy, and gas adsorption analysis. Their magnetic data indicate that the products both exhibit weak antiferromagnetic (AFM) interactions, however, the Gd-BCA-3D shows stronger AFM coupling in comparison to the Gd-BCA-2D. Hence, the AFM coupling could be controlled by controlling the metal cluster in the MOFs to tune magnetic properties.

(144)
Solving the hardest problem in mathematics: the Riemann HypothesisSolving the hardest problem in mathematics: the Riemann Hypothesis

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The Riemann hypothesis is a problem that has stumped the world of mathematics for over 200 years, so much so that $1 million has been promised to anyone who can provide a conclusive proof. The hypothesis states that the non-trivial zeros of the Riemann Zeta function, a function of complex variables, all have the same real part. Though first discussed in the context of number theory and abstract mathematics, more recently it was proposed that the solution could be found by relating the function to a quantum mechanical system. In particular, the Hilbert-Pólya conjecture suggested that

the non-trivial zeros of the function correspond to the eigenvalues of a Hamiltonian operator. If the operator could be shown to be Hermitian, then the Riemann hypothesis would follow. Since then a number of possible Hamiltonians have been proposed, and in 2017 the Bender-Brody-Müller Hamiltonian was published by Physical Review Letters. We analyzed the validity of the Bender-Brody-Müller Hamiltonian, testing the claims outlined in the paper and comparing them with criticism from other experts in the field. We were able to show that these claims did not hold up upon closer inspection, and that the approach taken by the authors is not likely one capable of producing results. Here, we describe the issues found with this Hamiltonian, as well as future approaches that could potentially yield different results.

(145)

The Sex Dependent Role of TLR4 on Microglia in Depression and Pain States in Acute Ethanol ExposureThe Sex Dependent Role of TLR4 on Microglia in Depression and Pain States in Acute Ethanol Exposure

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Over half and 63.8% of alcohol abusers in the United States suffer from chronic pain and depression, respectively. Current literature centers on high alcohol use in depression and chronic pain states. However, to comprehend the root of these comorbidities, a recent study from our lab developed an acute, low-to-moderate model of 5% vol/vol liquid ethanol diet for a total of 14 days. Preliminary behavior results reveal that female mice develop mechanical allodynia as well as a trend towards depressive-like behaviors post ethanol exposure. Here we focused on Toll-Like Receptor 4 (TLR4), a receptor involved in inflammatory responses on microglia, the major immune cell of the brain. We hypothesize that TLR4 on microglia plays a role in short-term ethanol-induced depressive and pain-like states. We utilized a novel tamoxifen-inducible transgenic mouse model (cre-driven by Cx3CR1) that allows us to investigate the role of TLR4 on microglia only. To determine microglia activation, the brain was collected at day 15 post ethanol, and immunohistochemistry (IHC) was performed to visualize microglia in key brain regions. Microglia morphology, a proxy of microglia activation was quantified using imaging software. The histological data revealed that our paradigm induced differences in microglia activation states in female mice. Our results implicate the sex dependent role of TLR4 on microglia in the development of ethanol-induced depression and chronic pain.

(146)

Analyzing Online Discussions to Characterize Security Attributes of Generative AI ModelsAnalyzing Online Discussions to Characterize Security Attributes of Generative AI Models

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Generative AI models have attracted large amounts of attention for their ability to produce various forms of content and for the growing ability of any internet user to produce content with them. The explosion in use of these models stems from both access to trained models through the Internet as a service and from users being able to train models themselves to generate any content they wish. The increasing adoption of this technology raises concerns about its security and privacy in regards to how it is used and what larger impact it has. In this research, we develop a method to analyze security problems and implications of generative AI models based on the online discussions. The results provide new insights to identify and mitigate abuses of generative AI models.

(147)
Social Communication Profiles Among 24-Month-Old Toddlers with an Older Autistic Sibling

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Social communication deficits can be observed as early as 9-months-of-age in infants who later receive an autism diagnosis. Research has shown that there is heterogeneity in the way behavioral symptoms present in autism. The goal of this project is to identify the profiles of social communication in early childhood. The Communication and Symbolic Behavior Scales-Developmental Profile (CSBS-DP) is a standardized assessment used to evaluate social communication skills. It utilizes a system of 7 cluster scores: emotion and eye gaze, communication, gestures, sounds, words, understanding, and object use. High cluster scores indicate high social communication skills. This study included data from 24-month-old participants recruited as part of the IBIS study. All toddlers were at a high-likelihood for autism based on having an older autistic sibling (N=176). Latent class analysis was performed on their CSBS cluster scores which revealed three groups (Class 1: N=56, Class 2: N=105, and Class 3: N=15). Autism diagnoses of the participants were determined at 24-months-old using the DSM-IV-TR. Class 1 was comprised of 5.40% autistic toddlers. This class had the highest overall CSBS cluster scores. Class 2 had slightly lower cluster scores compared to Class 1, and 21% of the toddlers met criteria for autism. Class 3 displayed the lowest overall cluster scores, and 86.7% of toddlers met criteria for autism. Overall, there is heterogeneity in autism social communication profiles early in development. The results suggest that intervention plans should be tailored to meet the specific needs of the toddlers based on their individual social communication skills.

(148)
Distinct Structural and Mechanical Signatures as Potential Biomarkers for Early-Onset Colorectal CancerDistinct Structural and Mechanical Signatures as Potential Biomarkers for Early-Onset Colorectal Cancer

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Colorectal cancer (CRC) remains one of the deadliest cancers worldwide. Over the past decades, there has been a decline in average-onset CRC (AO CRC, above 65 years) accompanied by an increase in early-onset CRC (EO CRC, under 50 years). The precise etiology of EO-CRC remains unknown and there are no biomarkers allowing early detection, though preliminary results indicate that inflammation is at play in EO CRC. Collagen remodeling and overall tissue stiffening are hallmarks of fibrosis and inflammation. Thus, we hypothesize that fibrotic stiffening of the colon is a quantifiable biomarker of EO CRC. We investigated both cancerous and matched normal samples for each patient undergoing surgical resection. Each sample was subjected to local indentation and global compression to determine its mechanical properties. Histology was conducted to determine the underlying content and organization of fibrillar collagen. Tissues from EO CRC are significantly stiffer than AO CRC. Interestingly, not only cancerous but also normal tissues from EO patients are stiffer than those from AO patients. These mechanical trends are corroborated by trends in the collagenous microstructure. With respect to AO, normal EO tissues display densification and thickening of collagen, while cancerous EO tissues display the emergence of thin and aligned collagen fibers. Fibrotic stiffening of tumors is known to impact cancer progression and metastasis. Here, we find that also normal tissues from EO patients, not only cancers, are stiffer than their AO counterparts, thus suggesting that fibrotic stiffening could be used as a marker of EO CRC.

(149)

Simulating Contacts to Two-Dimensional Materials

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Simulating Contacts to Two-Dimensional Materials Thomas Conner1 1 Department of Materials Science and Engineering, The University of Texas at Dallas 2 Undergraduate Research Apprenticeship Program (URAP) Transistors made of semiconductor materials are a fundamental device in modern electronics and are used in the construction of nearly every electronic device since their creation. Silicon has historically been the material of choice when constructing transistors due to its semiconductor properties and its abundance. However, the emergence of two-dimensional materials, atomically thin materials, has created new possibilities in transistor design. Transition metal dichalcogenides (TMDs), atomically thin semiconductors, possess unique electronic properties and offer a potential evolution in the construction of transistors. However, high amounts of contact resistance in contact points between TMDs currently inhibit their use in transistor design. We are interested in exploring top-oriented contacts and tuning hyperparameters in these contacts to minimize contact resistance. Our lab uses Python scripts developed by researchers in our group to simulate contact points between two TMDs and Bayesian Optimization libraries to find preferable hyperparameter tuning and create mathematical models capable of accurately predicting contact resistance at these points. Using these tools, we have observed that reducing the Schottky Barrier Height and increasing doping concentrations yields minimal contact resistance in top-oriented contacts. Future research may use these discoveries and methods to further minimize contact resistance as well as prototype contacts between TMDs.

(150)
Optimization of Encasement Geometry and Fuel Additives for Improved Performance of Hybrid Rocket Motors

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Hybrid rocket motors offer an efficient compromise, bridging the mechanical design complexity of bi-propellant fuel systems and the attractive simplicity of solid rocket motors. One promising approach to enhance the performance of hybrid rocket motors is the use of novel 3D printed fuel grains. Previous studies have demonstrated that the advanced shapes achievable with encased fuel grains significantly improve regression rate and specific impulse. However, designing an optimized encasement geometry for fuels like viscous kerosene gel or cast paraffin wax presents a challenging task. This project aims to optimize the encasement geometry for various proven fuels while conducting a rapid design matrix study to evaluate the effectiveness of metallic fuel additives. Additionally, comprehensive data on specific impulse and combustion behavior will be collected. To facilitate accurate testing of our configurations, we will construct a dedicated setup capable of measuring the performance. The setup will have a custom safe and reliable ignition system, and measure important metrics such as chamber pressure, thrust, and oxidizer injection pressure. The results of this study will contribute to the expanding literature on hybrid rocket motors and fuel grain optimization. These insights will be valuable for the design and performance enhancement of hybrid rocket systems, ultimately advancing the field of hybrid rocket technology.

(151)

Neuronal Activity in Locus Coeruleus and Dopaminergic Mid-Brain Nuclei induced by Right Cervical Vagus Nerve Stimulation

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Left vagus nerve stimulation (l-VNS) is a therapeutic strategy for stroke recovery, drug-resistant epilepsy, and depression. The neuroplastic effects of FDA-approved l-VNS are well documented, however, the effects of right cervical vagus nerve stimulation (r-VNS) have been largely ignored. Recent studies have shown that significant differences exist between the anatomical and functional connectivity of the right versus left vagus nerves and the central nervous system. Here, we aim to characterize neural activation in the locus coeruleus (LC) and dopaminergic midbrain nuclei induced by r-VNS in naïve rats. We hypothesize that neural activation in the dopaminergic midbrain nuclei will be stronger after r-VNS than after l-VNS or sham stimulation. We further hypothesize that LC neural activation will be driven by both r-VNS and l-VNS but not by sham stimulation. To compare l-VNS versus r-VNS driven neuronal activity in our regions of interest, stimulating cuff electrodes were implanted around the right or left cervical vagus nerve of 5 adult Long-Evans rats. After surgical recovery, rats received VNS or sham stimulation as they freely explored an open field for 1 hour each day for 5 days. On the last day animals were transcardially perfused and their brains were extracted for histological analysis. Brains were sectioned and were stained for tyrosine hydroxylase and cFos. cFos expression was compared between l-VNS, r-VNS, and sham treatment groups. Understanding more about lateralization within vagal-mesencephalic signaling pathways is expected to inform the development of new therapeutic strategies for VNS.

(152)
Investigating the Binding of the Mig1 Yeast Transcription Factor to G4 DNA

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G4 DNA is a non-canonical DNA structure that forms in guanine-rich regions in the genome. Interactions among ≥ 4 guanine bases form tetrad structures called G-quartets that can stack on top of each other to form highly stable G4 DNA structures. Prior bioinformatics analyses have revealed that G4 DNA-forming sequence motifs are commonly found in functional regions of the genome including promoter regions. This suggests that G4 DNA may play a role in transcriptional regulation. However, there is limited knowledge concerning the molecular basis of proteins capable of interacting with G4 DNA at gene promoters. Previous research in the Kim Lab identified a yeast transcription factor, Msn2, that is capable of binding to G4 DNA through its C2H2 zinc finger domain. We speculate that the C2H2 zinc-finger domain could be a new G4 DNA binding domain. The current project involves investigating if one of the other C2H2 zinc finger transcription factors, Mig1, is capable of binding to G4 DNA. To test this hypothesis, the sequence coding for the zinc finger domain (amino acids 1 to 107) of Mig1 was cloned into a pGEX4T1 plasmid to express the GST-Mig1(1-107) protein. The expression of GST-Mig1(1-107) protein in E. coli BL21(DE3) cells was successfully confirmed by western blotting using anti-GST antibodies. The protein will be purified and then used in electrophoretic mobility shift assays with DNA oligonucleotides capable of forming G4 structure and appropriate controls to determine if Mig1 can bind to G4 DNA.

(153)
Characteristics of Sputtered Ruthenium Oxide

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Implantable micro-electrode arrays (MEAs) are widely utilized for neural recording and stimulation purposes. To ensure stable and reliable performance over an extended period, these devices require electrodes with a low impedance. Metal-based electrodes have been commonly used for neural recording and stimulation studies. However, they have limitations such as high impedance, low charge injection capacity, and potential cytotoxicity caused by ion dissolution during stimulation. Metals like iridium oxide (IrOx) have also been widely used as electrode coatings in neural devices due to their low impedance and high charge injection capacity compared to other materials. Recent studies show Ruthenium oxide (RuOx) as a viable alternative electrode coating material for chronically implanted neural interfaces. Previous investigations have explored RuOx in supercapacitors and biosensing applications, highlighting its enhanced electrochemical properties. There has been a lack of comprehensive evaluation of RuOx as a material for long term application. This research aims to assess the electrochemical properties of RuOx coatings over a period of 17 weeks using electrochemical impedance spectroscopy (EIS) measurements ranging from 100 kHz to 10 Hz and cyclic voltammetry (CV) with a sweep of 50 mV/s from –0.6 to +0.6 V vs Ag|AgCl. Electrochemical characterization of RuOx microelectrodes has shown improved charge storage capacity and lower impedance. The findings indicate that the electrochemistry of the RuOx film electrode remained stable when exposed to a control solution of phosphate buffer saline (PBS). Thus, the results demonstrate the long-term stability of the RuOx material, highlighting its potential as a promising choice for recording electrodes.

(154)
Endothelin-1 Treatment Impairs Mitophagy in Retinal Ganglion Cells

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Purpose: We sought to understand whether the administration of ET-1 in the eye impairs the process of mitophagy in RGCs, which could be an underlying mechanism of glaucomatous damage.
Methods: Male and female retired breeder Brown Norway rats were intravitreally injected with either 2 nmol ET-1 in the experimental group or Vehicle (water) in the control group. Following injection, rats were euthanized at 24 hours or 72 hours, and their eyes were sectioned. The sections were stained using specific antibodies to TOM20 (marker of mitochondria) and either LAMP1 (marker of lysosomes) or LC3B (marker of autophagosomes) in separate experiments.
Results: LAMP1 was significantly decreased in the RGC layer 24 hours following ET-1 injection ($p=0.0475$). TOM20 was significantly increased 72 hours following ET-1 injection ($p=0.003$). LC3B was significantly decreased 72 hours following ET-1 injection ($p=0.02$). The significant increase in TOM20 was also found in additional retinal sections stained with TOM20 and LC3B ($p=0.0004$).
Conclusion: ET-1 treatment on retinal cross sections from Brown Norway rats caused a significant reduction in engulfment of damaged mitochondria by autophagosomes (LC3B) during mitophagy, as well as a lesser number of lysosomes (LAMP1) in the cell. Additionally, a significant increase was found in TOM20 at 72 hours, indicating insufficient mitophagy of damaged mitochondria. Impaired mitophagy will lead to injury of RGCs and their axons due to the increase in reactive oxidative species in RGCs, which could be one of the contributions underlying neurodegeneration of RGCs by ET-1 in glaucoma.

(155)

Comparison of a High Aspect Ratio Truss-braced Wing Against a Traditional Top Mounted Wing in a Small Unmanned Aerial System at Low Speed

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The Truss Braced Wing (TBW) is a novel concept currently being researched by Boeing in partnership with the National Aeronautics and Space Administration. The TBW is claimed to increase efficiency in aircraft design through the introduction of a high aspect ratio wing. The bending moments about the roll axis resulting from a high aspect ratio wing require external support from a truss structure emanating from the fuselage of the aircraft. Previous TBW studies have been conducted on high-speed aircraft with swept wings but have neglected slower and smaller aircraft with rectangular wings, such as small Unmanned Aerial Systems (sUAS). The aim of this study is to evaluate and explore the performance impacts of a TBW concept in a sUAS. Digital aerodynamic simulations examining the stability, induced drag, viscous drag, lift, pressure distributions, moments, and stability will be used in simulation software to examine the effects of a truss on a sUAS. A comparison to an identically modelled sUAS lacking a truss structure will be conducted to better understand the impacts of a higher aspect ratio wing on the performance of a sUAS. Determining the impact of a TBW on a sUAS will provide the basis for the novel concept's implementation into the Advanced Air Mobility industry, potentially impacting the global logistics system's ability to deliver small packages and transport people in a more efficient and timely manner.

(156)
Renewable Electricity Generation and Political Partisan Affiliation in the United States

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The current climate crisis gives rise to a polarizing debate across the United States; Republicans and Democrats continue to offer competing visions on climate and energy issues. Reluctance toward a renewable energy transition is partly due to said parties' polarization. This study examines the correlation between renewable electricity generation in the United States and political partisan affiliation. A hypothesis is tested on whether renewable electricity is correlated with the partisan votes of Democrats on a state level. Using data from the United States Environmental Protection Agency (EPA) and the Federal Election Committee (FEC), the data is compiled to categorize two decades of election years from 2000 to 2020 for 50 U.S. states (excluding Puerto Rico and the District of Columbia). With the 2008 energy production data unavailable from the Environmental Protection Agency, data averages from 2007 and 2009 were determined as a replacement. Formulations such as correlational analysis were then used to determine trends throughout the voting years, revealing an average r-value of -0.02, concluding a minute negative correlation between Democrat party affiliation and renewable electricity generation per state. While the debate itself on renewable energy and its connections with various political parties can be highly polarizing, the weak correlation in the data suggests further complexity.

(157)
Identifying Essential Protein-Protein Interactions Between the KSHV Viral GPCR and Host ProteinsIdentifying Essential Protein-Protein Interactions Between the KSHV Viral GPCR and Host Proteins

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Kaposi's sarcoma-associated herpesvirus (KSHV), an oncogenic herpes virus, is the causative agent of Kaposi's Sarcoma (KS). KS is predominant in sub-Saharan Africa, Mediterranean countries, and immuno-compromised individuals worldwide. KSHV encodes for a viral G-protein coupled receptor (vGPCR), a transmembrane signaling protein, which contributes to the inception of KS. A major project in the lab is focused on identifying protein-protein interactions (PPI) between host proteins and vGPCR to determine PPI that are essential during KSHV infection. Our current goal is to optimize a protocol to isolate vGPCR and conduct Western Blot (WB) analysis, a critical component of PPI validation. My aim for the summer is to compare RIPA lysis buffer to other lysis buffers (eg. Mem-PER) in order to investigate cell lysis, and membrane protein extraction efficiency. Using a light microscope, we observed lysed cell membranes versus intact cell membranes when the cells are treated with Mem-PER and RIPA respectively. Since vGPCR is a transmembrane protein, we hypothesize that Mem-PER will be a more effective lysis buffer and extract the viral protein for WB analysis. Ultimately, our goal is to optimize a WB protocol in order to validate PPI between vGPCR and host proteins.

(158)
The role of pre-sleep arousal in explaining the association of romantic relationship quality and sleep in Hispanic/Latino parentsThe role of pre-sleep arousal in explaining the association of romantic relationship quality and sleep in Hispanic/Latino parents

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Sleep health is associated with romantic relationships; people in better-quality relationships report better sleep. However, it is not known how relationships are related to sleep. Pre-sleep arousal, the ability to calm down before sleep (e.g. reduce racing thoughts and sympathetic arousal), may be an important mechanism through which relationships are related to sleep health. Thus, this study aims to examine the associations between daily conflict and romantic relationship quality and determine if pre-sleep arousal explains these associations in Hispanic/Latino primary caregivers of children aged 1-5. To address these aims, Hispanic/Latino primary caregivers (N = 43) took part in a 10-day diary study. They reported on romantic relationship conflict and quality each night and sleep (duration, quality, and continuity) and pre-sleep arousal (both somatic and cognitive arousal) each morning. We predict that greater conflict (lower quality) in romantic relationships will be related to more pre-sleep arousal, which in turn will predict poorer sleep. Data analyses are currently being conducted. If these hypotheses are supported, it would highlight the need to incorporate relationship functioning when addressing sleep health.

(159)
Association Between Female and Male Speech Input and Child Language Development

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Developing infants tend to hear more speech from their mothers than their fathers. Yet there is limited research on how differing amounts of each gender's speech affects child language development. The current study used home language environment data from Language Environment Analysis (LENA) recorder kits, and child language ability (words produced and understood) data from the MacArthur Bates Communicative Development Inventory. Utilizing this data, the impact of the quantity and ratio of adult male and female speech on child language development was explored. Aim 1 examined longitudinal male and female speech quantity in the home environment across 6, 9, and 12 months. Results indicated a significant main effect of gender, $F(1,26) = 165.610$, $p < 0.01$, with female speech

to infants being more common; however, the gender and time interaction was not significant. Aim 2 examined the correlation between the amount of summed male or female speech across 6-12 months and child language at 12 months. Results indicated that infants who heard the most female speech across 6-12 months understood the most words at 12 months, $r(26) = 0.214$, $p < 0.05$; no other models were statistically significant. Aim 3 examined if the proportion of male to total speech was associated with child language at 12 months. Results revealed no significant associations. Overall, these results affirm previous literature's findings that infants hear more speech from female caregivers than male caregivers, and that speech from female caregivers is associated with child language skills.

(160)
Synthesis and Doping of Inorganic 0D Cs3CdBr5 to Induce Self-Trapped Exciton EmissionSynthesis and Doping of Inorganic 0D Cs3CdBr5 to Induce Self-Trapped Exciton Emission

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In recent years, materials that can emit light through Self-Trapped Exciton Emission are showing promise due to their applications in electronics and scintillation. X- ray scintillators need heavy nuclei. Zero dimensional Cs3CdBr5 is a good candidate as a X- ray scintillator due to its heavy atomic composition. Phase pure Cs3CdBr5 is not expected to be photoluminescent so doping was pursued. Phase pure Cs3CdBr5 crystals were synthesized using different molar ratios in an evaporation method, and confirmed to be nonemissive at room temperature. Doped samples were synthesized each with one of the three different dopants, Zn2+, Sb3+, or Cu+. Characterization of these different samples was done through powder x-ray diffraction, UV-Vis spectroscopy, and photoluminescence spectroscopy (emission and excitation). These different doped samples were synthesized to determine if they possess different optical properties from phase pure Cs3CdBr5. In studying these optical properties, doped Cs3CdBr5 could be deemed as a worthy x-ray scintillator.

(161)
Studies Worked on Overcoming Chronic Pain

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The experience of pain is one of the fundamental human senses and the most ancient protective survival skills. It can be contexted as an unpleasant sensory and emotional experience with actual or potential tissue damage. However, Chronic pain (A.K.A persistent pain) carries out for three to six months, around 1.5 billion people worldwide and 19.4 million people in the U.S. suffer from this significant medical condition that affects their daily lives. Methods that were used to treat chronic pain were the use of opioid drugs that relax the body and relieve acute pain. Contrarily, there are minimal studies that are efficient for chronic pain management as it can be very controversial when taken prolonged, leading to dependency, and even increased pain. This comes to the outcome that the lack of an alternative therapeutic for chronic pain, along with the overprescription of opioids led to an opioid crisis that happened in the year 2018 where an estimated 130 people died every day due to opioid-related drug overdoses. Breaking the barrier of sex amongst pain medication with studies being reconciled that the use of Mice genetically engineered to lack D5 receptors showed significantly reduced pain responses only in males and not in women. Researchers also found that both the gene manipulation and the pharmacological inhibition of MNK protected against and reversed spontaneous pain and cognitive impairment. With these findings, we could potentially put an end to chronic pain.

(162)
A Peptide-based Approach to Characterizing the Cu(I)-binding Properties of hTMEM52B

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Copper, a trace transition metal, is essential to a multitude of cellular functions despite its relatively low concentration in the human body. It serves roles as an enzyme cofactor (e.g. SuperOxide Dismutase I), as a signaling ion (e.g. Cu(I) in neurons), and as an integral structural unit in metalloproteins (e.g. metallothionein). Copper possesses unique redox properties under physiological conditions that allow it to catalyze a variety of biochemical reactions other elements and compounds cannot. However, this redox activity requires strict regulation of the metal to prevent toxicity and oxidative damage. We have previously studied hTMEM52B, an orphan transmembrane protein, and demonstrated that it is a physiologically relevant Cu(I)-binding protein with an unidentified role in the metabolism of copper. In this project, we sought to elucidate its Cu(I)-binding mechanisms and properties to further understand the physiological role of hTMEM52B. This protein contains a singular predicted transmembrane domain, allowing for the exploitation of the intra- and extracellular domains of the protein in isolation using synthetically generated peptides. The discussed peptide-based method circumvents experimental complications associated with the highly hydrophobic transmembrane domain (e.g. detergents) and allows for the study of metal binding in isolated, representative environments. Spectrophotometric Cu(I) titration was used to investigate the Cu(I)-binding properties of hTMEM52B and its associated peptides, coupled with ligand-metal charge transfer (LMCT) analysis to provide further insight into the binding events. Affinity of the Cu(I)-binding sites, identified in the titrations, were then determined using UV-Visible absorption to track a competition experiment between Cu(I)-binding probes of known affinity and hTMEM52B/peptides of unknown affinity. With these tools, we report significant advances in the understanding of how, where, and for what purpose hTMEM52B binds copper and the role that it plays in human copper metabolism.

(163)
Computationally Predicting the Conformational Ensemble of Intrinsically Disordered Proteins

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Intrinsically disordered proteins (IDPs) play a critical role in the maintenance of biological systems. Unlike globular proteins, which have one or a few local minimal, IDPs have relatively flat energy landscapes, which reflect the broad range of possible conformations that are energetically degenerate. Intrinsically disordered regions are difficult to study using traditional structural biology methods. They are not visualizable by diffraction based structural biology methods and solution-state NMR provides information about the averaged conformation of IDPs; in contrast, dynamic nuclear polarization (DNP) NMR allows us to determine structure as cryogenic temperatures largely prevent conformational averaging resulting in broad peak shapes that provide experimental structural restraints for IDPs. Using a statistically generated ensemble of an intrinsically disordered protein, we predicted the peak shapes for frozen intrinsically disordered regions under DNP NMR conditions. We compared the predicted and the experimental peak shapes. Deviations between them can indicate structural preferences in these difficult to characterize regions. Certain conformations result in the development of plaques that can spread, resulting in neurodegenerative disease states. Understanding structural preferences may lead to the development of structure-specific therapies.

(164)

A novel optogenetic split-enzyme system to control protein-protein interactions in the secretory compartment of cells

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Optogenetics is a flourishing field of study that harnesses light to artificially induce interactions within animal cells. In a developing animal embryo, the application of light allows manipulation of early embryonic signals with high spatial and temporal precision. Processing of developmental signaling proteins within the secretory compartment of cells is important for the proper formation of tissues. We set out to control enzymatic processing of secreted proteins via light-controlled reconstitution and subsequent activation of split enzymes in the endoplasmic reticulum (ER). First, to assist reconstitution of the split enzyme halves, we tested various dimerizing coiled-coil helices that were each fused to each half. The coiled-coils dimerize via hydrophobic and electrostatic interactions to elicit a strong binding response. We introduced our two-component split-enzyme system in single-cell zebrafish embryos and observed enzymatic activity in the ER, indicating reconstitution of enzyme function. Second, to induce split-enzyme reconstitution with light, we employed iLID/SspB proteins, which dimerize under blue-light stimulation. However, light-induced dimerization of iLID/SspB only occurs in the cell cytoplasm; thus, to preserve this function, we will fuse them to the split-enzyme constructs via a transmembrane domain derived from Stim1a (TMstim1a). TMstim1a-fused split enzymes were injected in zebrafish embryos and were found to colocalize in the ER membrane. Last, we will fuse iLID/SspB at the cytoplasmic ends of the TMstim1a-fused split enzymes and test whether blue light induces enzyme reconstitution and function in vivo.

(165)
Antibiotic Activity of Bacterial Isolates Sourced in UT Dallas Soil

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ESKAPE pathogens are six bacteria identified by the WHO as the most dangerous pathogens resistant to antibiotics. The Tiny Earth Initiative seeks to isolate new antibiotics from soil bacteria to counteract the loss of current antibiotics due to resistance by ESKAPE pathogens. The Tiny Earth Initiative has already established that it is possible to isolate antibiotic-producing bacteria from soil. In this experiment, soil taken from a drainage ditch at UTD was tested for bacteria that showed antimicrobial activity against non-pathogenic bacteria that are genetically similar to ESKAPE pathogens. The primary goal of this experiment was to isolate and identify soil bacteria that show antimicrobial properties against safe relatives to ESKAPE pathogens. To do this, soil from a drainage ditch was collected and diluted serially. These dilutions were plated on agar, and individual colonies that grew on the plates were tested against ESKAPE relatives. Four isolates produced zones of inhibition against ESKAPE relatives and were selected for 16S rRNA gene sequencing and biochemical tests. Antibiotic metabolites effective against Escherichia coli, Bacillus subtilis, Enterococcus raffinosus, Enterobacter aerogenes, Acinetobacter baylyi, and Erwinia carotovara were produced between the four selected isolates that were also determined to be Pseudomonas. Isolate R2A06 produced a broad-spectrum antibiotic metabolite, while isolates TSA01, TSA02 and R2A08 produced narrow-spectrum antibiotic metabolites. The relevance of this research is that novel antibiotics that ESKAPE pathogens are sensitive to could be produced by these four isolates, creating potential treatments for infections caused by antibiotic-resistant bacteria.

(166)
Developmental Trajectories of Binge Eating Symptoms in Relation to Reward Sensitivity, Cognitive Control, and Emotion Regulation

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Although Binge Eating Disorder (BED) is the most common eating disorder, the mechanisms characterizing its development and trajectory are relatively unknown. BED shares symptoms with addiction (e.g., loss of control) suggesting the involvement of similar reward and self-regulatory systems. Here, we tested reward sensitivity, cognitive control, and emotion regulation as potential mechanisms in the development and maintenance of BED symptoms. We predicted that increases in reward sensitivity and emotion dysregulation, and/or decreases in cognitive control would be associated with an increased likelihood of developing or maintaining BED symptoms. Using a longitudinal dataset (n=7,854; Adolescent Brain Cognitive Development Study), participants were categorized into four groups based on BED symptoms endorsed at baseline and year two: no symptoms, developers, maintainers, and remitters. To test how reward sensitivity and self-regulation affect membership in these groups, a multinomial linear regression was run using measures of reward sensitivity, cognitive control, and emotion dysregulation as predictor variables. Model results demonstrated that greater emotion dysregulation was associated with an increased likelihood of membership across groups, whereas increases in reward sensitivity specifically corresponded with an increased likelihood of membership in the developer group. Increases in drive corresponded with an increased likelihood of membership in the remitter group. Cognitive control was not associated with any specific group membership. These results indicate that while emotion dysregulation may not be a mechanism specific to BED symptoms, reward sensitivity may play an important role in the development of BED symptoms over time while drive plays a role in the abatement of symptoms.

(167)
Obesity-Induced Effects on Oviductal Tissue Homeostasis

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The prevalence of obesity has escalated dramatically over the past few decades with approximately 42.4% of American adults being categorized as obese. In addition to being linked to metabolic dysfunction, obesity is associated with infertility and poor prognosis in various cancers, including ovarian cancer. The fallopian tube (FT) plays a key role in fertility and is also implicated as the site of origin of aggressive ovarian cancer. However, the effect of obesity on FT tissue homeostasis remains unknown. We sought to determine the impact of obesity on the FT using the mouse oviduct (OD) as a model system. We investigated the distribution of epithelial and mesenchymal cell types, including metabolic-sensing cells, in the OD of mice fed a high-fat diet (HFD) compared to a matched control diet. We also examined Platelet-Derived Growth Factor Receptor alpha (PDGFRα)-expressing cells given that PDGFRα is associated with poor prognosis among ovarian cancer patients. Using immunofluorescence, we observed an increase in oviductal cell proliferation in HFD mice compared to controls as well as changes in the distribution of metabolic-sensing cells. We are continuing to investigate the dynamics of distinct epithelial subsets and PDGFRα+ cells in our model. Our goal is to identify cell-type specific alterations in the OD induced by obesity that can advance our understanding of obesity-associated infertility and ovarian cancer.

(168)
Comparing Task Engagement in Rats Receiving Right Versus Left Vagus Nerve Stimulation

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Currently, left vagus nerve stimulation (l-VNS) is an FDA-approved treatment for chronic stroke recovery. Our laboratory's preclinical findings indicate that clinically relevant l-VNS can lead to a small but significant reduction in motivation, as measured by decreased task engagement in some animals during stimulation-paired lever pressing tasks. As drop-out rates are a major issue in conventional stroke rehabilitation, strategies to reduce this VNS-induced change in motivation may improve treatment efficacy. Right vagus nerve stimulation (r-VNS) has been shown to activate midbrain dopaminergic nuclei and increase motivated task engagement. In this study, we aim to directly compare the effects of r-VNS and l-VNS on motivated behavior. Female Long-Evans rats were trained on a skilled lever-pressing task in which they received a food pellet upon a successful lever press. After achieving behavioral criteria, the rats were implanted with a stimulating cuff electrode around the right cervical vagus nerve. Post-recovery, rats received 0.5 seconds of 30 Hz stimulation paired with correct lever-pressing during five final training sessions. Sham groups were treated identically, except no stimulation was delivered during the final five days of training. Based on prior studies from our lab, we hypothesize that r-VNS may increase lever-pressing when compared to l-VNS. Analysis of lever pressing behavior explores the impact that right versus left VNS has on motivation.

(169)
Call Graph-Driven Delta Debugging

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Software errors negatively affect the reliability and security of software, necessitating fixes before deployment. However, the debugging process is often slow and tedious, taking up large amounts of development time. While the research community has developed various automated approaches for software debugging, these techniques are still limited in their applicable scenarios. For example, delta debugging, an automated approach, reduces the erroneous input into a smaller equivalent, allowing for easier localization of the error using the smaller inputs. It works by iteratively executing the program many times with different reduced inputs, which is computationally expensive. For structured inputs, more efficient algorithms can be created to consider the specific structure of the input. It has previously been shown that combining two delta debugging algorithms with different granularities, the first acting on the class level and the second acting down to the statement level, demonstrated an increase in speed for source code reduction. In this research, we create a novel algorithm utilizing information gained from a call graph of an input program. Using a breadth first search, we apply a modified version of Hierarchical Delta Debugging to the breadth first tree of the call graph. This algorithm reduces on a method level, giving it a granularity complementary to existing algorithms. We built the implementation into an existing two-staged delta debugger, allowing easy integration with the other algorithms. We will evaluate the three-staged delta debugger on multiple programs and expect that this will result in decrease in execution time compared to the two-staged version.

(170)
Examining the Effect of Civil Society Activity on Government Compliance with International Courts

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The participation of non-governmental actors in the policymaking process has been a key factor in legislators' strategic decisions for years. Civil society organizations (CSOs), such as advocacy groups, professional associations, and cultural institutions, carry out the critical role of holding the government accountable in support of the public welfare. Much of the existing research on CSO

activity revolves around their influence on domestic policy outcomes. Less has been said about how CSO activity affects governmental behavior abroad, particularly in compliance with authoritative international courts. International courts are important mechanisms for accountability infrastructure within domestic politics because they uphold civil liberties and protect against abuses of power. Consequently, non-governmental actors have an interest in enforcing government compliance with international courts because they can employ court rulings to improve domestic human rights standards. Therefore, the purpose of this project is to examine the effect of civil society activity on how quickly states comply with international court decisions. I hypothesize that as CSOs become more active in the policymaking process, the less time it will take for state governments to reach full compliance with court rulings. I tested this theory using Harvard Dataverse data on the European Court of Human Rights (ECtHR) in tandem with data taken from the Varieties of Democracy (V-Dem) dataset. This project encompasses all ECtHR cases up until June 2016. Current results from this data are generally in support of the stated theory.

(171)
Identifying Potential Inhibitors for E. Coli Efflux Pump TolC to Combat Antibiotic Resistance

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Drug discovery is a race against evolution, with new drugs being synthesized to counter mutations that make pathogens immune. But the time-consuming process of drug discovery has created a gap and pathogens are becoming resistant at a faster rate. Scientific focus has therefore shifted towards creating adjunct medications to renew the efficacy of older drugs. The target structure for the adjunct was identified as the surface efflux protein of E. Coli, TolC, due to its ability to pump out antibiotics which makes the organism resistant. TolC has one identified inhibitor called Cobalt Hexammine, but it does not reduce MIC value of antibiotics due to its weak binding affinity, hence a need to screen for stronger ligands. The database DrugBank was screened using Autodock Vina docking software and ligands with significantly better binding affinities were selected for similarity searching. Lastly, the best binding structures were manually edited to improve binding affinity. Over 50 ligands were identified as potential inhibitors and their similarity search yielded in ligands with an affinity of -11.0 kcal/mol. Manually editing resulted in a further improvement to -11.2 kcal/mol. The better affinities indicate that these ligands form more stable bonds than Cobalt Hexammine and will hence need to be tested for inhibition in laboratory trials. It should be noted that the initial search was conducted using Drugbank, which only contains currently approved drugs, and that a larger database can be screened for a more exhaustive study

(172)
Characteristics of Sputtered Ruthenium Oxide

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Implantable micro-electrode arrays (MEAs) are widely utilized for neural recording and stimulation purposes. To ensure stable and reliable performance over an extended period, these devices require electrodes with a low impedance. Metal-based electrodes such as platinum, tungsten, titanium nitride, indium tin oxide (ITO), and gold have been commonly used for neural recording and stimulation studies. However, they have limitations such as high impedance, low charge injection capacity, and potential cytotoxicity caused by ion dissolution during stimulation. Metal oxides like iridium oxide (IrOx) have also been widely used as electrode coatings in neural devices due to their low impedance

and high charge injection capacity compared to other materials. In recent studies, Ruthenium oxide (RuOx) has emerged as a viable alternative electrode coating material to iridium oxide for chronically implanted neural interfaces. Previous investigations have explored RuOx in supercapacitors and biosensing applications, highlighting its enhanced electrochemical properties. Electrochemical characterization of RuOx microelectrodes has shown improved charge storage capacity, lower impedance, and biocompatible material. material here has been a lack of comprehensive evaluation of RuOx as a material for long term application in neural interfaces. This research aims to assess the electrochemical properties of RuOx coatings over a period of 17 weeks using electrochemical impedance spectroscopy (EIS) measurements ranging from 100 kHz to 10 Hz and cyclic voltammetry (CV) with a sweep of 50 mV/s from –0.6 to +0.6 V vs Ag|AgCl. The findings indicate that the electrochemistry of the RuOx film electrode remained stable when exposed to a control solution of phosphate buffer saline (PBS). Thus, the results demonstrate the long-term stability of the RuOx material, highlighting its potential as a promising choice for recording electrodes.

(173)
The New Painter

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The primary goal of The New Painter is to expound upon existing creative practices in the field of painting and demonstrate how to apply new techniques in a digital age for the next generation of visual artists. Ideally, students engaged with The New Painter will be able to broaden and diversify their knowledge of painting and how different mediums mesh together. Not only this, but they will also be engaging with a community of developing/burgeoning painters in a forum of painters, for painters. To accomplish this, visiting artist-scholars have been enlisted to provide their input on new media art and the process of its production which will then be transfigured for an academic learning environment. Rigorous interviews inquiring about methods and creative processes will be regularly conducted with relevant artist-scholars to achieve this end. I have devised the questions to be asked to interested artists, and provided intimate analyses of their work. Workshops will also be established to provide a suitable environment for the involved artist-scholars of The New Painter and to build the aforementioned forum. This project was initiated due to a distinct prevalence of anachronistic instructional materials that are no longer applicable to emerging new media artists. The materials that do exist specifically for new media artists are also provincial in nature, and do not encompass enough beyond promoting proficiencies in certain art programs (which themselves are always becoming outmoded and supplanted by new programs).

(174)
Validation of a Novel Genetic Model to Study the Effects of Peripherally Restricted Cannabinoid 1 Receptors on Analgesia

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Chronic pain is a complicated sensory experience that affects millions of adults worldwide. Individuals struggling with pain are usually prescribed opioids, however, opioids have a high potential for abuse. To find a treatment with less side effects, cannabinoids have been a suggested new analgesic. The receptor that binds cannabinoids, cannabinoid receptor 1(CB1R), regulates neuronal communication and physiological processes, specifically those leading to pain and inflammation. However, cannabinoids have psychoactive effects. Through validation assays, we expected to generate a model to investigate the function of CB1R on nociceptive sensory neurons to avoid side effects from CB1R expression in the central nervous system. In this model, the cre-lox system is used to flank a

transcriptional blocker (TB) by lox-p sites. When cre is present and driven by the Nav1.8 promoter, CB1R is selectively expressed by only cre containing peripheral sensory neurons. To verify the selective re-expression of CB1R, assays were performed to observe transient receptor potential vanilloid 1 (TRPV1) co-localization, CB1R-mediated cyclic adenosine monophosphate (cAMP) decrease, and CB1R activity in the gut. Lastly, polymerase chain reaction (PCR) was used to confirm that the TB and cre were present in our offspring. CB1R gene expression in lumbar dorsal root ganglia showed that knockout mice have less CB1R than their wildtype counterparts, and reactivated mice had similar CB1R expression as wildtype mice. Forskolin-induced cAMP accumulation and gut motility decreased, validating nociceptive independence and knockout specificity. PCR confirmed that the TB and Nav1.8 promoter were in the proper gene alignment.

(175)
Zinc-Doped All-Inorganic Cs7Cd3Br13 to Prove Emission Center in a Dual-Polyhedra System

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Inorganic cadmium halides have gained traction in recent years due to their ability to emit light through self-trapped excitons (STEs). Materials that have efficient STE emissions show promise towards applications involving UV down-conversion as well as scintillation. Cs7Cd3Br¬13 is a unique luminescent material in which there are two cadmium coordination centers, one within one-dimensional octahedral [CdBr4Br2/2]3- chains and the other within free-floating zero-dimensional [CdBr4]2- tetrahedra. This material emits orange photoluminescence under UV light at room temperature, but this emission blueshifts as temperature decreases. However, it remains unclear which cadmium center is responsible for these emissions. To try and prove if the emission center changes as temperature decreases, zinc was used as a dopant to replace cadmium. Zinc was picked specifically because it has a similar electronic structure to that of cadmium and zinc prefers to be in a tetrahedral coordination rather than octahedral coordination. By selectively replacing the cadmium of the zero-dimensional tetrahedra, any optical changes that are observed can be attributed to that specific coordination within the crystal structure. To do this, a slightly modified version of a pre-existing solvothermal synthesis method was used to form batches of single crystals, which grow as colorless needles. Characterization of Cs7Cd:Zn3Br13 samples was done through powder x-ray diffraction analysis, UV-Vis spectroscopy, and photoluminescence spectroscopy to prove that zinc was properly incorporated into the crystal structure and induced optical changes as hypothesized. In studying this, the specific emission center(s) of Cs7Cd3Br13 can be found and modified to fit a wide variety of applications.

(176)
Insertion Mechanics of Intracortical Amorphous Silicon-Carbide Neural Probes in Animal Models

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Intracortical microelectrode arrays (MEAs) are implantable devices that can record neuronal electrical activity and are used to control brain-machine interfaces. However, after implantation into the cortex, MEAs trigger a foreign body response (FBR), limiting the ability of the device to record over time. It

has been shown that MEAs with smaller cross-sectional areas, called ultramicroelectrode arrays (UMEA), are capable of largely evading the FBR. However, it is more challenging to insert such smaller devices because of their higher flexibility, which may lead to buckling before penetrating the cortical surface of the brain. Here, we evaluated the insertion mechanics of different geometries (200 µm2 and 300 µm2 cross-sectional area and 1.3, 1.5, and 1.7 mm length) of amorphous silicon-carbide (a-SiC) MEAs that can facilitate unaided cortical implantation in three different animal models (rat, pig, macaque). The first part of the study focused on calculating the critical buckling force (Fc), or the maximum compressive axial force of each MEA geometry. The second part of the study focused on measuring the force of penetration (Fp) of a-SiC into rat, pig, and macaque cortexes and the success rate of insertion of each probe. The Fp and Fc were compared using a two-way ANOVA to determine statistical significance. Results showed that the lower the force of penetration and higher the critical buckling force, the higher the success rate of insertion.

(177)
Making Psychological Research Less W.E.I.R.D!

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The sciences often recruit from a WEIRD population -- White, Educated, Industrialized, Rich, and from Democratic nations. Ninety-six percent of all published research relies on individuals derived from communities that adhere to those standards (White, 2020). In order to have research samples that truly reflect the human population, it is necessary for scientists to actively recruit and include individuals from different cultural backgrounds. One area where work is needed is the processing of facial expressions. As is typical of western research, many of the canonical studies of facial expressions have used images of young, white men. Some efforts have been made to create more inclusive stimuli, but there are still limitations. For instance, the FACES database was created in 2010 to be more age-inclusive. This database contains images of young, middle-aged, and older individuals displaying neutral, disgust, sad, angry, and happy facial expressions. However, this database only contains Caucasians. Because of known biases in processing and emotional identification in other races, it is critical to create stimuli that portray diverse populations. To fill this gap, we are taking photographs of individuals from the two most predominant racial minority groups in the U.S.: Black/African American and Hispanic/Latine. Once validated, these photos will be shared with other researchers on the Open Science Framework (OSF) for use in future research projects. For example, a future study could use our data in conjunction with the original database to test intra- versus outer-racial trust.

(178)
Conversation Metrics and Impression Formation during Social Interactions between Autistic and Non-Autistic Adults

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Differences in social preferences, communication styles, and modes of understanding can present barriers during interactions between autistic and non-autistic people. In the current study, conversations between 70 dyads of unfamiliar autistic and non-autistic adults were quantified and correlated with how each partner viewed the other. Specifically, each participant’s speaking duration, words spoken, questions asked, and turns taken were correlated with their partner’s ratings of them on the First Impression Scale. Results indicated that questions asked by autistic but not non-autistic participants were associated with lower ratings on attractiveness ($r=-.25$, $p<.05$) and interest in

hanging out (r=-.33, p=.01), with trends towards being rated as less likable (r=-.24, p=.06) and trustworthy (r=-.24, p=.07). Similarly, more turn-taking by autistic participants correlated with their partners being less interested in hanging out with them (r=-.32, p=.01), with trends towards liking and trusting them less, and less interest in conversing with them and comfort around them (rs>.22, ps<.09). More questions and more turn-taking shifts may occur when conversation is stilted, with partners filling gaps with a series of discreet questions and answers. Autistic participants appear to be penalized more for this than non-autistic ones. Relatedly, non-autistic participants were rated as more likable when they talked longer (r=.40, p=.001) and used more words (r=.34, p<.01). In contrast, words spoken by autistic participants were related to partners rating them as more intelligent (r=.31, p=.01). Collectively, these findings suggest that conversation metrics are not uniformly predictive of partner perception and differ for autistic and non-autistic people.

(179)
Accelerated Aging of Mixed Metal Oxide Coatings for Neural Recording and Stimulation Electrodes

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(180)
The Effects of Medical Offloading Boots on Gait

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Weight shifts during walking are critical for balance and locomotion optimization. The body's center of mass transfers cyclically from one leg to the other, initiated by the leading foot. As the body progresses over the stance leg, weight shifts anteriorly, achieving maximal displacement during midstance. These coordinated weight shifts facilitate stable and efficient ambulation. Patients afflicted with diabetic foot ulcers are often required to wear medical boots to provide protection and support to the affected foot. By offloading pressure from the ulcer site and distributing weight more evenly, medical boots help alleviate pressure points and prevent further injury, allowing the ulcers to heal effectively. Although it is very helpful, the rigid construction and bulkiness of medical boots may alter the normal biomechanics and gait pattern, resulting in a sense of discomfort or awkwardness during ambulation. Furthermore, the protective nature of these boots impedes normal foot and ankle movement, contributing to a sensation of restricted mobility and unfamiliarity. This can lead to patients losing balance and falling thus risking further injury. We are interested in seeing if offloading shoes significantly alters one’s gait cycle. The Participant performed 4 movement tasks with and without a medical offloading boot. During walking trials, the average gait speed of the patient was 1.25 m/s while the average speed with the boot was 1.07 m/s. Comparing the two sets of data will show us what aspects of ambulation an offloading shoe impact most. Future studies will compare physiological data to determine how it impacts energetics.

(181)
Graphic Novel in Motion: Land of a Thousand Machetes

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This animation research project is a collaboration with the Dallas Holocaust and Human Rights Museum focused on the translation of an educational graphic novel about genocide in Rwanda into a cinematic motion comic short film. Each 2D panel within the novel is deconstructed into multiple image files which are then reconstructed in 2.5D animated image composites allowing for character performance and visual effects. The result is an engaging retelling of the graphic novel which explores Dr. Gregory Stanton's Ten Stages of Genocide.

(182)
Graphic Novel in Motion: Year Zero

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This animation research project is a collaboration with the Dallas Holocaust and Human Rights Museum focused on the translation of an educational graphic novel about genocide in Cambodia into a cinematic motion comic short film. Each 2D panel within the novel is deconstructed into multiple image files which are then reconstructed in 2.5D animated image composites allowing for character performance and visual effects. The result is an engaging retelling of the graphic novel which explores Dr. Gregory Stanton's Ten Stages of Genocide.

(183)
Evaluating the Reliability of Language Environment Analysis System and Voice Type Classifier to Analyze the Child Language Environment

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Past research has indicated that the early language environment plays an important role in child language development. To measure the language environment, various technologies exist to record and categorize speech. The most popular tool is the Language Environment Analysis (LENA) system which consists of a recording device and closed-source software to analyze speech. The Voice Type Classifier (VTC) is an open-source software that categorizes speech. Both LENA and VTC classify speech into four categories - key child (child wearing the recorder) vocalizations, adult female speech, adult male speech, and other child vocalizations. The goal of the current project is to outline the steps used to carry out a validation study of the LENA and VTC programs. To measure the accuracy of these programs, the recordings are manually segmented to compare software results to human judgement. Manual segmentation involves annotating speech for each speaker type. The data in this project comes from a longitudinal study of 30 infants who contributed data at 6, 12, and 24-months of age (10 infants at each time point). Each participant provided a 16-hour recording, and out of it, raters manually segment 19.2 minutes of audio that is separated into 39 randomly selected, 30-second clips. Results from manual segmentation will be compared with LENA and VTC results to determine which program is best suited to characterize study-specific language samples. Establishing the program that can provide a more accurate assessment of the language environment will enable future research to more effectively characterize participants' home language environment.

(184)
Arterial curvature has minor impact on the wall mechanics of patient-specific atherosclerotic coronary arteries
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Coronary artery disease (CAD) is one of the leading causes of death in America, and yet studies identifying the impact arterial geometry has on wall mechanics at an individual level are lacking. The wall stress within the coronary arteries has been found to play an important role in the development and growth of the plaque associated with CAD. Here, we examine the effects that curvature of a coronary artery has on structural stress, especially near atherosclerotic lesions. Utilizing an in-house tetrahedral finite-element approach, sixteen 3D artery models were developed based on clinical intravascular ultrasound-virtual histology (IVUS-VH) images from four patients. For each patient, there are four models: straight, curved 30 degrees, 60 degrees, and 90 degrees. The elements were assigned materials and properties corresponding to the IVUS-VH identification. The wall stresses at systolic pressure were calculated using FEBio and 95% confidence intervals were calculated. The results from these simulations indicate the overall average wall stresses from each model was between 20 and 70 kPa. Within each individual, the differences between the straight artery and the corresponding 30-, 60-, and 90-degree curved arteries were 0.940 +/- 0.157, 1.564 +/- 0.274, and 2.327 +/- 0.38 kPa, respectively. As expected, the greater the curvature the higher the stress difference. However, we note that the makeup of each artery was found to play a greater role in its level of stress and the differences found between the straight and curved arteries are negligible to the overall wall stresses.

(185)
Palmitic Acid Activates Peripheral Sensory Neuron TLR4 Receptor to Induce Mechanical Allodynia and Hyperalgesic Priming

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A Western diet is characterized by a high intake of fat and sugar and low nutritional content. Previous research in our lab has demonstrated that a short-term high-fat diet induces pain hypersensitivity (allodynia) following treatment of a sub-threshold inflammatory mediator, Prostaglandin E2 (PGE2), in male and female mice. However, the components of the high-fat diet that contribute to cellular priming and sensitization are still unknown. The aim of this research is to investigate the effect of palmitic acid (PA), a major fatty acid in the high-fat diet, on sensory neurons. We hypothesize that PA interacts with toll-like receptor 4 (TLR4) on sensory neurons to lower the pain threshold and induce allodynia in mice in the absence of obesity and hyperglycemia. We utilized a mouse model that exclusively expresses TLR4 on peripheral nociceptors (Nav1.8 -/+TLR4TB/TB) in order to study the effect of PA on sensory neurons. We compared the pain sensitization of the Nav1.8 -/+TLR4TB/TB mice to mice with whole-body knockout of TLR4 (TLR4TB/TB) and wild-type (WT) mice. The mice received an intraplantar injection of a sub-threshold dose of PA, followed by an injection of sub-threshold PGE2 either 24 hours or 7 days post-PA. In both sexes, Nav1.8 -/+TLR4TB/TB and WT mice exhibited greater pain hypersensitivity (allodynia) compared to the TLR4TB/TB mice, suggesting that PA primes sensory neurons via TLR4 interactions. With this research, we can further explore the mechanisms behind this response caused by the high-fat diet, and the clinical applications it has on obesity and chronic pain.

(186)
Crystal Growth and Characterization of Hydrogen-Rich Antimony Halides for Mixed Field Radiation Detection with the [A2SbCl5] Geometry

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Organic-Inorganic metal-halide hybrids (OIMHs) have displayed a great deal of promise in a variety of photophysical applications, with their antimony-based constituents serving as efficient, nontoxic alternatives to the typical lead halide perovskite. One such application is mixed -field radiation detection, the detection of multiple forms of radiation using a single material. This class of materials has many potential uses in the fields of security, imaging, radiation-based therapy, and experimental physics. OIMH compounds contain the light, hydrogen-rich, organic compounds needed for fast-neutron detection and the heavy inorganic scintillators needed for X-ray detection within the same material, making them uniquely suited for mixed- field detection.

To harness this potential, we turned to a series of pre-existing benzyltrialkylammonium antimony chlorides with an A2SbCl5 stoichiometry based on square pyramidal SbCl5 units, with –methyl (TMBA) and –ethyl (TEBA) as the respective A site alkyl substituents. These compounds display high photoluminescence quantum yield (PLQY) above 90% and are bright yellow/orange emitters with excitation values between 590-620nm and emission values between 350-360nm, increasing in value with respect to alkane chain length. In an effort to produce larger and cleaner products fit for synchrotron testing, the published methods of crystal growth were studied and refined to improve crystal sizes beyond 4mm in diameter. Characterization of these compounds via photoluminescence spectroscopy, UV-Vis analysis and powder X-ray diffraction confirmed synthesis of the goal compounds, along with their near-unity quantum yields.

(187)
Visible Light-Induced Metal-free Remote C(sp3)–H Borylation of Amines

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Alkyl amino boronates are important motifs in drug discovery, organic synthesis and material science, prompting demand for methods for their facile installation, ideally via activation of ubiquitous C–H bonds present in feedstock amines. Although methods of C–H borylation at proximal sites are well-explored, borylation of the less-accessible and stronger remote C–H bonds remains highly challenging. We have previously demonstrated a photoinduced, metal-free α-borylation of aliphatic amines via intramolecular hydrogen atom transfer (HAT). Inspired by that, we hypothesize it would be possible to use radical translocation approach for borylation of β- and γ-positions by using different tethers to activate remote, rarely-accessible C–H bonds. We herein report an operationally simple, robust method of β- and γ-borylation of aliphatic amines employing commercially available iodo-pyridine and iodo-sulfonamide tethers respectively. This metal-free reaction features formation of electron donor-acceptor complex of tethered amines with diboron reagent, which upon photoexcitation triggers aryl radical generation. A subsequent site-selective 1,5-HAT or 1,7-HAT in the desired position generates a key alkyl radical and is followed by trapping of the latter with diboron reagent to furnish the desired product. In conclusion, this visible light-induced, mild method allows selective installation of boronic esters in feedstock amines, which fills an underexplored gap in remote C–H borylation and can be applied for late-stage functionalization of complex amines.

(188)
Effects of Chronic In-Vivo Stimulation on Recording Performance in Platinum/Iridium Electrodes

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Microelectrode arrays, used for recording brain activity, are being explored as tools for chronic stimulation applications like neuroprosthetics. Recent preliminary data has demonstrated that Pt/Ir electrodes can produce reliable chronic percepts. Yet, the effect of long-term stimulation on recording quality remains unclear. This study compares the performance of stimulated and non-stimulated electrodes within Pt/Ir microwire arrays to investigate the impact of chronic stimulation on recordings. We implanted 12-shank Pt/Ir microwire arrays into somatosensory cortices of three male rats, recording activity at two-, eight-, and 16-week timepoints. Using a go/no-go stimulation paradigm, we pulsed 30 electrodes four hours/week at 0-4 nC/ph; six remained un-pulsed. We then evaluated recording performance using metrics such as active-electrode-yield, signal amplitude, noise levels, spike rate, and signal-to-noise ratio. Statistical analyses included equivalence tests, mixed-effect analysis, and a repeated measures ANOVA. Equivalence tests revealed a significant difference in spike rate between stimulated and non-stimulated electrodes ($p = 0.01$). However, neither time nor stimulation effects on spike rate were found significant in the mixed-effects analysis. The remaining metrics, including active-electrode-yield, signal amplitude, noise, and signal-to-noise ratio, showed no significance in either analysis ($p > 0.2$). Finally, the ANOVA showed overall stability for each array in active-electrode-yield across timepoints ($p = 0.38$). Despite non-equivalence in spike rate, our overall analysis displayed that Pt/Ir microwire arrays remained stable up to 16-weeks post-implantation. This aligns with their ability to reliably produce stimulation-evoked percepts, highlighting their durability for long-term stimulation and recording applications. Future experiments involve comparing recording performance to ultra-flexible-silicon-based arrays.

(189)
Evaluation of Platinum/Iridium Microwire Arrays for Chronic Multi-Channel Stimulation of Rat Somatosensory Cortex

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Intracortical microstimulation through microelectrode arrays has shown utility for neuroprosthetic applications. However, failures such as electrode de-insulation, gliosis, and changes in charge storage capacity demonstrably alter impedance and voltage magnitudes during chronic in-vivo applications. In this study, we investigate electrochemical changes and stability for microwire arrays during multi-channel stimulation of rat somatosensory cortex. We implanted 3 rats with 12-channel Pt/Ir microwire arrays and monitored perception thresholds with electrochemistry weekly through a go/no-go behavioral paradigm where animals received stimulus pulse trains through 10 channels concurrently. Electrochemistry implemented a 3-electrode configuration to measure electrochemical impedance spectroscopy against Ag/AgCl; maximum cathodal potential excursion (Emc) was assessed by recording 15 µA single-channel voltage transients against a transcranial stainless-steel screw. Non-linear regression was used to estimate thresholds, while linear regression assessed stability up to 31 weeks post-implantation. The animals produced average perception threshold of 1.9 nC/ph with non-significant slope from zero ($p = 0.19$) of -0.05 nC/ph bi-weekly, indicating perceptual stability. Electrochemistry results displayed significant increase of 0.5 mV/week ($R2 = 0.7$) for average Emc, while 1 kHz impedance exhibited significant decrease of -0.7 mΩ/week ($R2 = 0.4$); both $p < 0.01$. Electrochemical analysis suggested de-insulation due to increase in Emc and decrease in impedance. However, chronic perception threshold stability shows arrays could produce consistent stimuli with negligible material property changes. Overall, this study's preliminary data exhibits why Pt/Ir microwire arrays should be considered for chronic stimulation studies in rat somatosensory cortex. Future experiments will compare stimulation-evoked perception thresholds and performance against ultra-flexible silicon-based arrays.

(190)
Inter-Rater Reliability of Emotional Expressions in Racial Minority Models

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The FACES database (https://faces.mpdl.mpg.de/imeji/) is an influential database of young, middle-age, and older adults displaying six facial expressions: neutrality, sadness, disgust, fear, anger, and happiness. The database contains only Caucasian individuals. Our goal is to expand this database by creating complementary images of individuals from the two most predominant racial minority groups in the U.S.: Black/African American and Hispanic/Latine. Replicating the original FACES procedures, our photo sessions had three phases: (1) emotion induction phase, (2) personal experience phase, and (3) controlled expression phase. Each session produced approximately 200 photographs per model. After the photo session, we completed a photo selection procedure to identify the two images for each model that best represented each of the six facial expressions. Two independent raters did a blind rating of each picture using standardized questions, assessing (1) the presence of the target emotion, (2) the intensity of the emotion, and (3) whether the emotion was blended. Cohen's kappa will be calculated to assess inter-rater reliability. Similar to what was seen in the original FACES study, we hypothesize that raters will have the most difficulty agreeing on expressions of sadness and disgust. The most consistently, highly-rated images from this photo selection procedure will be used in an online validation study that will evaluate the images in terms of facial expression, perceived age, and perceived race. Overall, this study is the first step in creating a more representative database of stimuli, ultimately facilitating the inclusion of more diverse populations in psychological and neuroscience research.

(191)
Enhancing NLP-Based Python Decompilation through Masking Complex Data

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The evolving cyber-threat landscape requires advanced techniques for analyzing malware. Decompiling Python bytecode plays a crucial role in understanding malicious software written in this popular and platform-agnostic language. However, the decompilation problem is challenging due to Python's fast update cycle. Grammar-based decompilation approaches are exceedingly complex and labor-intensive. The Pylingual Project aims to reduce manual and time-intensive effort by leveraging Natural Language Processing (NLP) Artificial Intelligence. This study presents an innovative method to enhance NLP-based decompilation by preprocessing Python bytecode and source code through the masking of complex constants, names, and expressions.
The Pylingual Project utilizes a dataset of over 880,000 Python source files from the Python Package Index and CodeSearchNet. This custom dataset enables exploration of the diversity and complexity of real-life Python, facilitating the training of sophisticated AI NLP models.
Preliminary results indicate that the proposed preprocessing method, which focuses on masking complex elements using the Python Abstract Syntax Tree and our custom EditableBytecode system, yields superior decompilation results. By masking arbitrarily complex data, we reduce statement complexity and provide a refined representation of Python bytecode and source code, allowing our AI models to effectively "focus" on the crucial structure of the code.

(192)

Investigating Time Course in a Theory of Mind Task in Individuals with Psychotic Disorders, their Biological First-Degree Relatives, and Controls

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Theory of Mind (ToM), or the ability to understand the mental states of others, has been shown to have deficits in people with psychosis (PWP). Studies have also suggested the presence of ToM deficits in biological first-degree relatives (FDR) of PWP. Past studies have analyzed ToM deficits by utilizing the Triangles Task in which animations depicted two triangles moving on a screen in either a social or non-social way. To build on the existing knowledge of theory of mind deficits in PWP, we investigated the time it took for PWP, FDR, and controls (HC) to decide whether an interaction was social or non-social during the Triangles Task. We predicted that there would be a longer time for ToM processing for PWP compared to the control group.
88 PWP, 67 FDR, and 44 HC completed the Triangles Task. Participants viewed videos of animated triangles and selected if the triangles were moving randomly, in a goal-directed fashion, or moving with implied intentions. Participants pressed a button during the videos when they thought that they knew the answer.
Results showed a main effect for condition ($p = 0.005$) and a marginally significant effect for group in time course ($p = 0.051$). Post hoc tests showed trends for HC responding faster than PWP and FDR. These findings indicated that the PWP and FDR groups took longer to decide regarding attributing intentions during the triangles animations compared to HC.

(193)
Defining Polymyxin Resistance in Acinetobacter baumannii

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Acinetobacter baumannii infections are a significant threat to human health, particularly due to the increasing antibiotic resistance, including polymyxins like Colistin and Polymyxin B, which are the last resort against A. baumannii. This study aimed to understand the mechanistic basis of polymyxin resistance in A. baumannii. Using a machine learning model on clinical A. baumannii isolates, we identified 31 genes associated with colistin resistance, not previously recognized for polymyxin resistance. To explore their functional roles, we used the Manoil AB5075 transposon mutant library and antimicrobial susceptibility testing. Although the mutants didn't show colistin resistance, they exhibited distinct fitness phenotypes when exposed to sub-inhibitory colistin concentrations. Some mutants displayed increased membrane permeability, altered membrane potential, and enhanced biofilm formation when exposed to colistin. These observations prompted us to investigate if these phenotypes extend to other polymyxins. Interestingly, there was no significant difference in resistance between colistin and Polymyxin B among the 31 mutants. We plan to further study the fitness phenotypes, membrane properties, and biofilm formation of the mutants in response to Polymyxin B, relative to colistin, aiming to gain deeper insights into polymyxin resistance mechanisms. This study contributes to our understanding of A. baumannii antibiotic resistance and offers new approaches for combating multidrug-resistant infections.

(194)
Sigma-2 receptor/TMEM97 Modulates Modality Dependent Anxiety and Depressive Behavior Independent of Cognitive Interference

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The Sigma-2 receptor/TMEM97 (σ2/TMEM97) is a transmembrane protein found in the endoplasmic reticulum (ER) and the plasma membrane that is known to modulate biological phenomena related to emotional and cognitive disorders. Although putative σ2/TMEM97 ligands have been developed for treating psychiatric illness, scientific characterization of the σ2/TMEM97 receptor's role in modulating emotion and cognition using transgenic mice is limited. We have explored affective and cognitive behaviors that implicate the σ2/TMEM97 receptor and demonstrated that there is a potential phenotypic difference between TMEM97 knockout (KO) mice and wildtype mice in terms of anxiety and depression-like behaviors. Affective behaviors were assessed using open field, light dark preference, elevated plus maze, elevated zero maze, forced swim test and tail suspension test. Cognition was assessed using marble burying, nestlet shredding, novel object recognition and novel object location assays. Then, the results were standardized using a z-score analysis to create an emotionality and cognition score to determine if there was a potential affective and cognitive phenotype. The data showed modality dependent difference between anxiety and depression for TMEM97 KO mice including Z-score (ex. TMEM97 KO mice showing less anxiety and depression in light dark preference and tail suspension test but not in other assays). There was no significant cognitive phenotype at baseline and Z-score. These data suggest that any affective phenotypes can be separated from overt cognitive behavioral interference. Overall, these data demonstrate that σ2/TMEM97 may be of interest for its biological role in modulating anxiety and/or depression.

(195)
Assessment of Dyskinesia Using a Force-steadiness Task in Biological First-degree relatives of Individuals with Psychotic Disorders

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Spontaneous dyskinesia has been repeatedly reported in psychotic disorders and is hypothesized to be related to striatal dopaminergic dysfunction. However, findings of spontaneous dyskinesia in biological first-degree relatives (FDR) of individuals with psychotic disorders are mixed. Clarity on this issue can provide insights into the association of dyskinesia with genetic liability or disease-specific processes. Using data from the Psychosis Human Connectome Project, this study examined dyskinesia in individuals with psychotic disorders (n=116), FDR, (n=62), and controls (n=42). Dyskinesia was evaluated via a force steadiness task wherein participants applied a constant pressure to a load cell for two sets of three 15s trials with their dominant and non-dominant hands. Increased variability in the force signal reflects dyskinesia, arising from uncoordinated muscle contractions. Repeated-measures ANOVA was used to analyze force variability with group and sex as between-subjects factors, handedness as a within-subjects factor, and age as a covariate. Preliminary results revealed main effects of group (p<.001) and age (p<.001). Bonferroni-corrected post-hoc comparisons revealed greater force variability in patients compared to both relatives and controls (p's <.001), with essentially identical variability in relatives and controls. These findings suggest dyskinesia may be associated with disease-specific factors in patients rather than genetic liability.

(196)
Lanthanum's effect on phenotypic growth in Paracoccus denitrificans

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Regulatory promoters MxaXYZ of the bacterium Paracoccus denitrificans control the expression of XoxF, a predicted lanthanide-dependent methanol dehydrogenase, and of MxaF, a calcium-dependent methanol dehydrogenase. β-galactosidase assays in methanol media were conducted to assess function of both XoxF and MxaF; results suggest that while calcium-containing media fostered activity in both MxaF and XoxF, lanthanum-containing media limited the promoters' function. This may imply that lanthanum has an inhibitory effect on regulatory promoters MxaXYZ. β-galactosidase assays in lanthanum-containing methanol media were conducted on MxaX to test this theory, and lanthanum appears to inhibit this promoter's function as well. While growing the cultures in an aerobic environment, cell aggregation/death was observed in higher concentrations of lanthanum, possibly indicating that similar results would occur with cells grown in a static environment.
Biofilming, when cells grow in a thin layer on the surface of a structure, is one such static environment. Mutant strains lacking BapBCD, the Type 1 Secretion System, and BapA, a secreted protein that assists biofilming in Paracoccus denitrificans, were grown in calcium or lanthanum-containing media. Results indicate that lanthanum does have an adverse effect on biofilming. Furthermore, calcium-dependent biofilming seems to depend on a pathway that is non BapA and BapBCD. This finding, coupled with lanthanum's effect on methylotrophy, suggests that lanthanum likely directly inactivates multiple calcium-requiring enzymes/pathways.
Future research involves three interacting regulatory proteins: FlhS, FlhR, and FlhT, on which methylotrophic growth depends. These proteins will be deleted to determine their connection to Paracoccus denitrificans biofilming.

(197)
Encapsulation of Biomolecules in Large Pore PyCOFAmide to Enhance Sub-Unit Vaccination Efficacy

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Vaccination, a highly effective therapeutic option for preventing and treating various diseases, has been instrumental in saving millions of lives annually over the past century. Sub-unit vaccines with protein antigens have been recently developed to enhance safety and efficacy. Using mesoporous materials to deliver payloads and enhance vaccine efficacy shows promise but the toxicity of many of these materials complicates potential applications. Covalent Organic Frameworks (COFs) are porous, polymeric crystalline compounds that rely on robust covalent bonds between organic materials. COFs, with their organic nature and stability, have shown biocompatibility in vitro and possess the essential properties for effective encapsulation of payloads. Altogether, COFs demonstrate substantial promise for medical applications such as improved sub-unit vaccination efficacy.

Large pore COF, PyCOFAmide (COF) was selected as a vaccine platform by loading the model antigen ovalbumin (OVA) along with the adjuvant CPG. The large (6.5 nm) pores allowed encapsulation of these payloads in COF and facilitated a slow releasing antigen depot when subcutaneously injected into mice skin. These vaccine formulations were subcutaneously injected into 6-8 weeks old female BALB/c mice along with OVA, OVA-CPG and Saline control groups at Day 0 following a booster dose at Day 14. Cytokine ELISAs antigen-specific ELISA will be evaluated for the blood serum samples collected over the course if 28 days (Day 0, Day 7, Day 14, Day 21, and Day 28). According to the preliminary data, OVA-CPG@COF formulation substantially improved the antibody production enhancing the humoral immunity.

(198)
Comparative Methodologies for the Estimation of Stimulation-Evoked Perception Thresholds

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Microelectrode arrays show promise in generating artificial somatosensory experiences for individuals with sensory loss. However, few preclinical methodologies exist for reliably evaluating chronic stimulation-evoked perception thresholds in animals. This study compares our newly established acute threshold estimation methodology with a prominent chronic model from literature to determine the validity of our methods in long-term applications.
We implanted 12-channel Pt/Ir microwire arrays into the somatosensory cortices of three male rats and monitored their perception thresholds up to 32 weeks post-implantation. Perception thresholds were determined using a go/no-go behavioral paradigm with equal and simultaneous stimulation of 10 channels from 0-4 nC/ph. Average perception thresholds were estimated using non-linear regression, meanwhile linear regression assessed threshold stability over the chronic period. Lastly, model comparisons in threshold variance were made using an equivalence test.
The average perception threshold determined by our non-linear regression model was 1.9 nC/ph (9.5 uA). Linear regression revealed a non-significant slope from zero ($p = 0.19$) of -0.05 nC/ph bi-weekly, indicating stable thresholds over time. Furthermore, the equivalence test confirmed that the average thresholds of both methods were statistically equivalent ($p < 0.05$).
The results of our investigation indicated that our methodology was able to estimate chronic perception thresholds equivalent to the leading literature model, validating its deployment for future applications. Lastly, our model revealed perceptual stability over the chronic period, suggesting consistent stimuli delivery from Pt/Ir microwire arrays. In the future, we intend to compare these results with ultra-flexible silicon-based arrays.

(199)
Stimulating Pain-Induced Brain Transmissions Virtually: Using Protein Cell Markers as Anatomical References for a 3D Computational Model

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The central nucleus of the amygdala (CeA) is a brain region that plays a key part in transmitting noxious sensory information during neuropathic injury. Previously, our lab has created a 3D agent-based computational model of the CeA to simulate pain-induced neural behavior. To improve future iterations of current model, we studied the neurophysiology of two different CeA neuronal populations and their model output during targeted “modulation(s)”. Based on existing data, we hypothesize that neurons expressing protein PKC-Delta are pronociceptive and Somatostatin are antinociceptive. Toggling buttons on our model’s interface allow for the inhibition and/or activation of these cell types in the front (anterior) and back (posterior) of the CeA. We compared changes in pain predicted by the model during baseline (no modulation), and inhibition/ activation scenarios. We also explored options to better define sub-nuclei in the CeA. With immunohistochemistry (IHC), we localized calcitonin gene-related peptide (CGRP) protein in the mouse brain and found it to be concentrated in the capsular sub-nucleus of the CeA (CeC). Using this as an anatomical reference, we better defined the boundaries of the CeC within the model. In this project, we compared CGRP expression in slices to demarcation of the CeC found in two published brain atlases: the Allen Brain and Blue Brain Atlas. We found that CGRP expression has greater CeC boundaries compared to that of the atlases. Our

results will assist the creation of a more accurate computational model and can be used to make predictions for future wet-lab studies.

(200)
The Role of Political Affiliations in Initial Trust

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Trust plays a crucial role in human interactions and is typically built through direct experiences. Due to the frequency at which individuals encounter strangers in today's world, understanding how they develop trust becomes important. Previous research suggests that people tend to hold positive beliefs about members of their own social group (in-group). These beliefs can result in greater trust for in-group members, in comparison to those who are not part of your social group (out-group), who may appear less trustworthy. We are interested in learning whether initial levels of trust for strangers is influenced by group membership. We focus on political party groupings due to their relevance and extensive research in today's political climate. To investigate this, participants chose a political affiliation they identify with (Republican or Democrat) and played an economic trust game that simulated learning trust information from computerized partners that were either part of their political in-group (same political party) or out-group (different political party). Consistent with our hypothesis, we found that initial levels of trust were influenced by the political affiliations of both the participant and the partner ($p = 0.002$). This implies that participants show greater levels of initial trust with political in-group members than political out-group members. Future analyses will focus on measuring political affiliation as a continuous variable using a range of averaged scores, as well as how group membership affects learning trust information over time.

(201)
Improving the Kinetics of Fluorescent Sensors Using a Split-Fluorescent Protein SystemImproving the Kinetics of Fluorescent Sensors Using a Split-Fluorescent Protein System

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Fluorescent sensors have been used across a variety of scientific fields to study biological processes. We previously developed the CRISPR ChaCha system in human cells, which utilizes the tobacco etch virus protease (TEVp) to cut specific cleavage sequences and release CRISPR-dCas9 protein to enter the nucleus and promote the transcription of any gene. CRISPR ChaCha has been used to report the activation of cell receptors in response to extracellular ligands. However, the kinetics of gene induction is slow, due to either dCas9 taking time to activate a target gene, or TEVp being an inefficient protease for the system. Here we propose an alternative design – the ChaChaCha system – where we replace dCas9 with a split -fluorescent protein system that rapidly reconstitutes fluorescence in the nucleus. We tested 42 different proteases, including TEVp, to further improve the kinetics of our new system. Our data show that multiple proteases easily outperform TEVp in terms of efficiency, demonstrating higher levels of protease-induced reconstitution of fluorescence in human cells (HEK293T). We plan to use the best-performing proteases with cell receptors as rapid sensors of ligand-receptor activation in vitro and in vivo.

(202)

Reimagining the Chess Landscape: Unveiling Chapter 1 of Staunton's Blue Book"Reimagining the Chess Landscape: Unveiling Chapter 1 of Staunton's Blue Book

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Our website modernized the first chapter of a 19th century chess instructional text, The Blue Book of Chess by Howard Staunton. Our website, available at https://utdchess-test.my.canva.site/learn-from-staunton, features an intuitive interface, colors of green and orange to represent The University of Texas at Dallas, and interactive elements to enhance user engagement with an easy to understand interface. To achieve this modernization, a Short-term Working Group (SWG) of five students, under the guidance of Dr. Alexey Root, undertook several steps. Team members practiced chess rules, discussed terminology, and investigated historical context. Team members converted the descriptive notation within the original text to algebraic notation, making it more in line with contemporary practices. Team members replaced gendered language in the original text with inclusive gender-neutral alternatives, such as replacing “he” with “they.” Team members created chess diagrams to illustrate key moves and strategies. By leveraging modern technology and design principles, our project enables the first chapter of Howard Staunton’s text to be appreciated by a new generation of chess players.

(203)
Assessing calcium dynamics in FibroblastsAssessing calcium dynamics in Fibroblasts

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The merging of fields has been a hallmark of scientific advancement for millennia. By using targeted computational and mathematical techniques (i.e., signal processing and noise extraction), we merged aspects of computer science with our immunological study on fibroblasts to better understand their behavior. Fibroblasts are cells that compose connective tissue and are the major source of extracellular matrix. They are crucial in cell-to-cell communication and help decode the cellular surroundings to properly convey information to the appropriate cells. Calcium is an important signaling component in these pathways that regulates the activity of second messengers, gene expression, and many other intracellular processes. Understanding calcium dynamics could reveal relevant biochemical pathways in fibroblasts and help researchers understand how these pathways are used to transmit information. We utilized calcium imaging, a technique which uses changes in fluorescence to correlate calcium transience on a per cell basis. Our experiments yield large amounts of raw (fluorescence) data which was analyzed using the computational techniques. The calcium transience in fibroblasts displayed oscillatory behavior which we believe is altered when the cells are exposed to different conditions and treatments. We observed that skin fibroblast derived from female mice treated with an immune stimulus, lipopolysaccharide (LPS), had a significant increase in the calcium oscillation frequency compared to control groups. We observed three distinct oscillation frequency patterns, which lead us to develop an algorithm to determine if these were linked with specific intracellular pathways. We determined that one of these discreet oscillation motifs was upregulated after LPS treatment.

(204)
The effect of repetitive stress and exogenous corticosterone injections on the production of interleukin 6 and corticosterone in a mouse modelThe effect of repetitive stress and exogenous corticosterone injections on the production of interleukin 6 and corticosterone in a mouse model

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Migraine affects over 10% of the global population, posing a significant socioeconomic burden. Stress, a common trigger among migraineurs, activates the hypothalamic-pituitary-adrenal (HPA) axis, implicated in migraine behaviors. In animals, the release of corticosterone (CORT) serves as the primary stress hormone regulated by the HPA axis. Simultaneously, stress triggers the release of interleukin-6 (IL-6), an inflammatory cytokine that interacts with the HPA axis. Our lab developed a pre-clinical stress-induced migraine mouse model. Preliminary findings indicate that repetitive stress induces mechanical hypersensitivity in males and females, while migraine-like behaviors are observed in females following repeated CORT injections. In this study, we investigated the effect of repetitive stress and CORT injections on serum CORT and IL-6 levels in mice. Mice were restrained for two hours daily over three days, with blood collected before, during, and after the stress. CORT was injected for three days, and blood samples were taken before and after the injection. The data demonstrated a notable increase in serum CORT levels following exposure to stress or CORT injection for a duration of 30 minutes in both male and female mice. These levels subsequently returned to baseline after 24 hours, indicative of a stress response and subsequent recovery. Furthermore, in both males and females, the IL-6 levels exhibited an elevation at the 2-hour mark following stress exposure, followed by a return to baseline after 24 hours. Understanding how stress impacts GCs and IL-6 in the nervous system improves our knowledge of the intricate relationship between stress and migraine development.

(205)
Investigating Error Patterns in Emotion Recognition in Individuals with Psychotic Disorders and Their First-Degree RelativesInvestigating Error Patterns in Emotion Recognition in Individuals with Psychotic Disorders and Their First-Degree Relatives

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Emotion recognition is a significant component of nonverbal communication, but this skill was found to be impaired across patients with psychotic disorders and is associated with social functioning impairments. Past studies have also documented emotion recognition impairments in first-degree relatives, though the findings were inconsistent. To build from our previous findings of impaired emotion recognition in people with psychosis (PWP) but not in first degree relatives (FDR), we investigated error patterns in emotion recognition by examining the incorrect attributions to various emotions (false positive responses) in PWP, FDR, and healthy controls (HC). We hypothesized that PWP and FDR would show a bias towards false positive attributions to negatively valenced emotions.

251 participants (129 PWP, 78 FDR, and 44 HC) were recruited through the Psychosis Human Connectome Project and completed the Penn Emotion Recognition Task (ER40). The task required participant to select the correct emotion label for 40 photographs depicting happy, angry, fearful, sad, and neutral expressions.
The results showed a marginally significant interaction between false positive response and group, $p = 0.054$. Neutral response had the highest false positive rate across all three groups. Post-hoc tests revealed that in addition to neutral, sad and fear false positives also occurred more than some other false positives in PWP and HC, while FDR only displayed significantly more sad responses compared to other false positives.
These findings indicated that neutral was the most frequent false positive across groups, and that there may be subtle differences in false positive emotion attribution in FDR.

(206)

Getting Aroused: a Study of the Impacts of Profanity and Loudness on Emotional Arousal through FilmGetting Aroused: a Study of the Impacts of Profanity and Loudness on Emotional Arousal through Film

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Films have the capacity to elicit emotional responses in viewers by utilizing auditory features such as sound intensity and taboo speech. We examined how these prosodic and pragmatic features of language interact to influence film viewers' perceived emotional arousal. Seven films were analyzed for (i) number of curse words, (ii) perceived "badness" of expletives, (iii) sound intensity, and (iv) participants' ratings of affective arousal. Annotators rated each sentence for emotional arousal on a 1-9 scale, manually identified curse word timings, and rated the curses for perceived badness. Sound intensity for each sentence was acquired with speech analysis software. Multiple linear regression results identified a positive relationship between sound intensity and arousal for all but one film. The presence of a curse word and its perceived badness correlated with increased arousal, although the addition of further curses did not significantly increase the arousal of a sentence. Interactional effects between curse count and intensity, as well as curse badness and intensity, were found. These findings have clinical implications for understanding the role of emotionality in language disorders, such as post-stroke aphasia. Some individuals with aphasia preserve cursing and other types of "automatic speech" despite losing other typical language production. By delineating characteristics of arousing speech, we can investigate potential novel approaches to language therapies.

(207)

Functional translation of a molecular mechanism driving the transition from acute to chronic painFunctional translation of a molecular mechanism driving the transition from acute to chronic pain

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Injury-induced sensitization of nociceptors contributes to pain states and the development of chronic pain. The molecular mechanisms that govern the transition from acute to chronic pain have largely been misunderstood. Here, we aim to understand the molecular underpinnings of the functional activity of Ephrin type-B receptor 2 (EphB2) in both mouse and human dorsal root ganglia (DRG). EphB2 has a known role in driving axonal guidance through interactions with its ligand EphrinB2 in the central nervous system, leading to the establishment and strengthening of dendritic spines. We hypothesize that mitogen activating protein kinase – interacting kinase 1 (MNK1) plays a role in the downstream signaling pathway that causes hypersensitivity. We utilized calcium imaging to identify the involvement of MNK1 in the pathway activated by binding of EphB2 to its ligand, EphrinB2. We cultured wild-type (WT) and MNK1 knockout (KO) mice DRG. We utilized a sub-threshold dose of Prostaglandin E2, a known inflammatory mediator, to reveal molecular reorganization of the neuron. This indicates the hyper-excitable state of the neuron after priming through EphrinB2. The MNK1KO mice do not produce a response to PGE2, suggesting that MNK1 is necessary to induce hypersensitivity. To confirm our findings, we used immunocytochemistry (ICC) to verify the receptors of interest are indeed present in mouse and human DRG. Cultured cells were treated with antibodies staining neurons, EphrinB2, and other receptors that may be trafficked to the membrane as a result of downstream signaling pathways, such as PGE2 receptors, TRPV1 or NMDAR subunit 2B.

(208)

Hormones Drive Peripheral Nerve Innervation in the Adult Mouse Mammary GlandHormones Drive Peripheral Nerve Innervation in the Adult Mouse Mammary Gland

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Mammary glands are milk-producing organs that have unique developmental stages. Unlike other organs, mammary glands undergo remarkable tissue remodeling and regeneration postnatally during puberty, the regular estrus cycle, and pregnancy. The hormones estrogen and progesterone largely influence the proliferation, expansion, and differentiation of stem cells that lead to growth and mammary epithelial expansion. Like most tissues, the mammary gland is innervated at birth by peripheral nerves; however, peripheral nerve dynamics in the postnatal mammary gland is poorly understood. High nerve density is associated with poor prognosis in breast cancer patients; thus, it is crucial to understand the factors that influence nerve innervation and its consequent impact on mammary epithelial growth. In this study, we investigated peripheral nerve innervation in the mouse mammary gland during pregnancy and following hormone stimulation. During pregnancy, we observed elevated peripheral innervation in the mammary gland. Hormone treatment with estrogen and progesterone significantly increased nerve density. This data suggests that hormones may modulate peripheral nerve innervation in the mammary gland during heightened regenerative phases such as pregnancy. Further research would provide critical insight into the role of peripheral nerves on mammary epithelial growth and breast cancer.

(209)
Examining power schedules, search strategies, and mutators in fuzz testingExamining power schedules, search strategies, and mutators in fuzz testing

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Fuzz testing has emerged as a powerful tool for finding bugs in real-world software, and as a result, has become a vibrant area of research. Research papers often claim to improve specific fuzzer component(s), e.g., power schedules, search strategies, and mutators. However, they only evaluate these changes based on aggregated metrics (e.g., code coverage), which can be influenced by many factors and do not directly evaluate the individual improvements. Our research aims to i) create a new, well-structured methodology for evaluating fuzzers based on the internal mechanisms, ii) devise general assumptions regarding improved fuzzer components w.r.t fuzzing internal mechanisms, iii) examine the claims of several papers with a detailed analysis. To examine power schedules and search strategies, we evaluated AFLFast, K-Scheduler, Ecofuzz, and TortoiseFuzz. We reproduced the experiments stated in the papers, compiling and fuzzing the programs listed for the given fuzzers while adding instrumentation that provides a detailed view into the internal state of the fuzzer. We found little-to-no evidence that increased performance could be attributed to the claimed improvements. To evaluate mutators, we performed a literature review of 20 papers that claim improvements in the mutator stage and will: i) find a common consensus between papers regarding mutators, ii) create a methodology and metrics to evaluate mutators, iii) build a framework and write instrumentation to evaluate the chosen fuzzers against our new methodology and metrics. Our research highlights the necessity for a fine-grained framework for evaluating the internal mechanisms of fuzzers.

(210)
A novel optogenetic split-enzyme system to control protein-protein interactions in the secretory compartment of cellsA novel optogenetic split-enzyme system to control protein-protein interactions in the secretory compartment of cells

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Optogenetics is a flourishing field of study that harnesses light to artificially induce interactions within animal cells. In a developing animal embryo, the application of light allows manipulation of early embryonic signals with high spatial and temporal precision. Processing of developmental signaling proteins within the secretory compartment of cells is important for the proper formation of tissues. We set out to control enzymatic processing of secreted proteins via light-controlled reconstitution and subsequent activation of split enzymes in the endoplasmic reticulum (ER). First, to assist reconstitution of the split enzyme halves, we tested various dimerizing coiled-coil helices that were each fused to each half. The coiled-coils dimerize via hydrophobic and electrostatic interactions to elicit a strong binding response. We introduced our two-component split-enzyme system in single-cell zebrafish embryos and observed enzymatic activity in the ER, indicating reconstitution of enzyme function. Second, to induce split-enzyme reconstitution with light, we employed iLID/SspB proteins, which dimerize under blue-light stimulation. However, light-induced dimerization of iLID/SspB only occurs in the cell cytoplasm; thus, to preserve this function, we will fuse them to the split-enzyme constructs via a transmembrane domain derived from Stim1a (TMstim1a). TMstim1a-fused split enzymes were injected in zebrafish embryos and were found to colocalize in the ER membrane. Last, we will fuse iLID/SspB at the cytoplasmic ends of the TMstim1a-fused split enzymes and test whether blue light induces enzyme reconstitution and function in vivo.