UROC-PREP

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Elijah Acuña

Computer Science at University of Arizona

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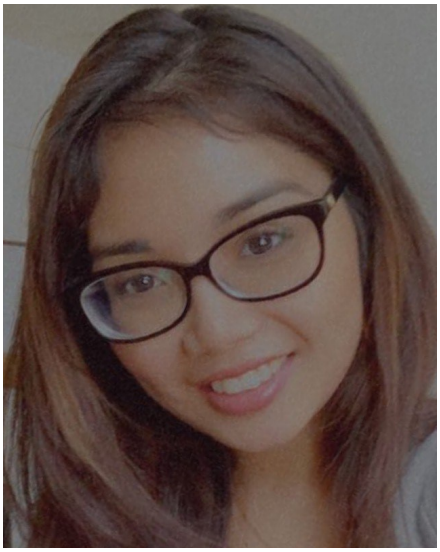
Comparative Analysis of Object Detection Models

ABSTRACT: Following the success of the Transformer (Vaswani et al., 2017) in Natural Language Processing (NLP), Vision Transformers have recently gained much more traction in vision model architecture. Some models such as Detection Transformer (DETR) (Carion et al., 2020)have combined the encoder-decoder aspect of Transformers with a convolutional processing layer. Other models such as Swin Transformers (Wang et al., 2021) have ditched convolution inf avor of a self-attention layer, gaining context across further apart image pixels. This work seeks to provide a centralized benchmark to various state of the art models with the aim of proving that Transformer-based detection models can output similar or better accuracy with a significantly better computational efficiency and a more generalized architecture. By achieving preferability in computational efficiency and generalizability, Transformers should be able to outperform convolutional vision models at a larger scale of dataset size and image resolution.

Jeanelle Juno Bautista

Neuroscience and Cognitive Science at University of Arizona

Mentored by Dr. Jessica Andrews-Hanna (Psychology)



We-talk Use in Couples and Relationship Satisfaction

ABSTRACT: We-talk within relationships refer to the use first person plural language (“we”) to describe aspects of the relationship that pertain to one or both individuals. Recent literature often studies we-talk in relationships as couples cope with and discuss one partner’s medical issues. Studies show a positive relationship between the occurrence of we talk when spoken by the supporting partner and patient care outcomes. This study hypothesizes that we-talk will further mediate relationship satisfaction in couples where both parties exhibit stable mental and physical health. To further examine how we-talk impacts relationship satisfaction in partners discussing topics of personal importance, this study will analyze the use of we talk in couples as they engage in 3 discussion tasks: supportive, disagreement and capitalization. The discussion goals of each task require language that may or may not involve the use of “we” and the implications of its use on relationship satisfaction within the context of each task will be examined. Results should be expected by the end of next month, following data analysis and interpretation.

Hillary Cowell

Molecular and Cellular Biology at University of Arizona

Mentored by Dr. Daniela Zarnescu (Molecular and Cellular Biology)

Deciphering the Effect of Frontotemporal Dementia Linked C9orf72 Repeat Expansion in *Drosophila melanogaster*

ABSTRACT: Frontotemporal dementia (FTD) is a neurodegenerative disease that alters an individual's personality and cognitive function. Characterized by behavioral symptoms, such as loss of working memory, sleep deficits, aggression, and lack of impulse control, FTD is a heterogeneous disease that is often misdiagnosed for other neurological conditions. Associated with multiple neurodegenerative disorders, C9orf72 is the most commonly mutated gene causing FTD. C9orf72 mutations comprise an expanded guanine and cytosine hexanucleotide repeat, G4C2 located within the first intron of the gene. G4C2 repeat expansions beyond thirty repeats become toxic, leading to FTD pathology. While G4C2 repeat expansions have been studied in animal models pertaining to singular FTD phenotypes, the molecular mechanisms underlying FTD remain poorly understood. *Drosophila melanogaster*, the fruit fly, has successfully modeled phenotypes exhibited in amyotrophic lateral sclerosis (ALS), another C9orf72-related neurodegenerative disease that affects motor neurons. The purpose of this study is to utilize *Drosophila* to establish FTD-relevant phenotypes to model the effects of C9orf72 repeat expansions. To this end, we express G4C2 repeat expansions in the mushroom body (MB) neurons in *Drosophila*, which are analogous to the frontal and temporal lobes in humans that undergo neurodegeneration and influence behavioral changes in FTD. By doing so, we assess how these repeat expansions affect MB morphology and FTD-relevant behaviors (e.g., sleep activity and working memory) in comparison to healthy flies. If successful, our model will establish concrete phenotypes to further research and elucidate the molecular mechanisms underlying C9orf72-linked FTD.

Caitlyn Flores

Microbiology at University of Arizona

Mentored by Dr. Koenraad Van Doorslaer (Animal and Biomedical Sciences)

Tracking the HPV Life Cycle Using a Recombinant Genome

ABSTRACT: High-risk human papillomaviruses (HPV) are responsible for the majority of cervical and head and neck cancers, making a significant contribution to the global cancer burden. HPV16 is the predominant type implicated in these cancers; however, cancer only occurs in a percentage of these infections. HPV demonstrates tissue tropism towards mucosal and cutaneous epithelial tissues by infecting the basal layer of the epithelium. The HPV life cycle exhibits both an early and late stage, and the completion of the life cycle is dependent upon host cell differentiation. 3D tissue models provide an ideal model for studying an active infection as they mimic living tissue by replicating stratification and cellular differentiation. Here, we investigate the transition between early and late-stage gene expression in tonsillar derived 3D tissue models by cloning a streptavidin binding peptide into an early and late segment of the HPV16 genome. E5 was identified as the optimal choice for early expression, as it is expressed in all early transcripts. L1 was selected as the candidate for late gene expression, given that it is the primary late gene and is differentiation dependent. Research on the transition between the early and late stage of the life cycle, and the host-viral interactions that take place during this transition, will provide insight on the risk factors associated with carcinogenesis within these infections

Evelina Henderson

Speech, Language, and Hearing Sciences at University of Arizona

Mentored by Dr. Mary Alt (Speech, Language, and Hearing Sciences)

Assessment of Infant Language Development in Sign Languages

ABSTRACT: There is a lack of language assessments for infants who are developing sign language. The first year of life is crucial in language learning as it lays a foundation for eventual mastery of the language. It is important to identify and treat language delays and disorders as early as possible. The present study explores elements of infant sign language such as sign babble and iconicity, for the purpose of discovering the current markers of developmental language impairment in infants learning sign as a first language. The study examines some of the assessment strategies that could be applied to the 0-12 month age range, drawing from existing assessments, in order to explore how to create a standardized assessment based on the markers of development. The study proposes future research that involves observation of a minimum of 50 infants who are learning sign language. Such observation would take place over the first year of the child's life, thus establishing a baseline of behavior for the subsequent development of a proposed assessment. The final step would be the testing and approval of the assessment for use in diagnosis.

Kendra Martinez

Psychology at University of Arizona

Mentored by Dr. Allan J. Hamilton (Neurosurgery)

Empathy Talks: Developing a Text-Based Generalized Measure of Situational Empathy Within a Clinical Medical Setting

ABSTRACT: As the implementation of artificial intelligence (AI) and machine learning become more prevalent, embracing the human factors of these technologies becomes vital, especially in fields such as medicine, where telehealth is becoming more of a norm. This need becomes increasingly apparent with events such as the COVID-19 pandemic. During the pandemic, a need for virtual solutions in areas such as telehealth and medicine were essential, as access to medical care became stressed. As a result, training medical students and staff also proved to be a challenge.

Normally, there would be an opportunity to practice patient interaction with Simulated Patients (or SPs), who are patients with a pre-determined backstory who would act as an actual patient would, and patients coming through a given clinic. Although video communications technologies have allowed for face-to-face contact to be possible virtually, viewing the screen may not be enough. By using a virtual aid such as an avatar based Virtual Patient System, there could be less of a disruptive impact on medical students and medical professionals in times similar to what was seen during the pandemic.

Within this course of study, the development of a generalized measure for situational empathy is discussed. In addition, the implementation of a scale for situational empathy into a virtual patient system (or VPS) is proposed, and the potential for future studies is examined.

Kyran Benedict Soriano

Physics; Mathematics at University of Arizona

Mentored by Dr. Alex Burant and Dr. Aditya Adiredja (Physics and Mathematics)

Designing an Effective Online Educational Physics Video with Supplemental Details

ABSTRACT: Supplemental details have been added in multimedia teaching to introduce additional learning materials beyond the primary content. Some studies have argued that including supplemental details enhances learning. However, adding supplemental details goes against the coherence principle, which states that all nonessential information in multimedia lectures should be eliminated to minimize demands on viewer's cognition. Thus, research needs to address specifics about how supplemental details should be delivered. The current project aims to design and film a video that optimizes the effectiveness of supplemental details. In future research, 60 physics majors taking first-semester calculus will view a video designed to include supplemental details about the Three Laws of Motion (e.g., information about inertia's role in a difficult skateboard trick, discussion of forces acting on a ferrofluid, etc.). Student's performance on the Force Concept Inventory will be used to measure the effectiveness of the design on the video. In addition, interviews will be conducted to gather suggestions from students to revise the film based on their perception of the topic and the video. The hypothesis is that students who learned under a specific length and placement of supplemental detail will demonstrate a higher understanding and appreciation of the topic than students who learned with no supplemental details. The results of this study will inform how to include supplemental details in educational videos. While evidence-based research supports the coherence principle, the final design of the video will suggest that supplemental details may mitigate the effects of the coherence principle in online learning settings.

Skyler Wyly

Neuroscience and Cognitive Science at University of Arizona

Mentored by: Dr. Robert Wilson (Psychology)

Blink Rates and Post-Error Slowing Under Real-World Decision-Making in the High-Stress Game Show *Mastermind*

ABSTRACT: Neuroscience decision-making experiments primarily take place in a laboratory setting because of the complexity of measuring neural activity. In order to extend beyond the limitations of the lab, neurally relevant information including blink rate, eye movement, and pupil size can be obtained directly from videos of the face. Blink rates are a cost-effective and non-invasive indicator of dopamine, a neurotransmitter associated with reward processing, making them a useful method for analysis of decision-making in new contexts that are more representative of authentic, real-world behavior. Decision research in game shows using blink rates as an indicator of dopamine offers a new approach to examining risk aversive decision-making. Game shows provide a good middle-ground between real-world and lab-based decision-making, with decisions that have more quantifiable probabilities. The television game show Mastermind, based on intense interviewing techniques, features a close-up view of the participant's face while answering rapid-fire questions with immediate feedback on the accuracy of their choice, making it ideal for video-based neuroscience. In this study, we focus on exploring post-error slowing and comparing participants' decision accuracy with changes in blink rate and response time through data analysis of video from pre-recorded episodes of Mastermind. Variations in blink rate and decision response time may be associated with the accuracy of a decision. This research furthers our understanding of the role of dopamine in decision-making and demonstrates the viability of using blink rate methods to study the neural mechanisms of decision-making in real-world situations.