Senior Projects
2023–2024

BASIS CHANDLER

SENIOR PROJECTS & SENIOR RESEARCH PROJECTS

At this point in their senior year, BASIS Charter School students have completed a set of four BASIS Capstone classes to earn their BASIS Honors Diploma. In addition, many students are in the process of completing the College Board's AP Capstone Diploma™, a challenging, two-year sequence of AP Seminar™ and AP Research™, plus four other AP® Exams—all of which require extensive research, writing, and oral defense. The BASIS Diploma Senior Project marks the culmination of this hard work and perseverance.

Completed in the third trimester of a student's senior year, the Senior Project is unique, self-designed, and reflective of each student's varied academic interests and passions. Regardless of the discipline—business, art, humanities, science, engineering, social work, medicine, or law—each senior must develop and explore a research question. Creating an abstract that sets the tone of the research, participating seniors must submit a project proposal, and later, orally defend their methodologies.

Under the guidance of an external advisor who is a professional in their field, as well as a faculty advisor from their school, students dedicate 10–15 hours per week to the completion of their Senior Project. To document their journey, students post weekly blog entries about their experiences, successes, and challenges as they explore their guiding question. This journaling provides a unique viewpoint on the students' activities and adds a reflective layer to their research process.

Throughout the development of the Senior Project, BASIS Charter Schools support their seniors every step of the way. The project summaries in this publication clearly illustrate each senior's ability to apply the knowledge and intellectual curiosity they have acquired in the classroom to professional research methods. At the successful conclusion of this project, students are eligible for a BASIS Diploma with High Honors, the most distinguished accolade offered by BASIS Charter Schools.

Each member of the BASIS Charter Schools network commends our seniors for their dedication and motivation—not only for completing this Senior Project, but for their commitment to the BASIS Charter School Curriculum. Congratulations to them on this powerful achievement, and our best wishes as they move forward on their educational journey.

Carolyn McGarvey
Chief Executive Officer
BASIS Ed AZ, DC, LA

David Hubalik
Chief Executive Officer
BASIS Ed Texas

BASIS® Chandler SENIOR PROJECTS

AASHIKA D.

EXAMINING THE EXPOSURE OF ENVIRONMENTAL FACTORS AND THEIR ASSOCIATION TO THE PROGRESSION OF NEURODEGENERATIVE DISEASES USING WASTEWATER-BASED EPIDEMIOLOGY

SUMMARY: Have you ever considered wastewater analysis to detect health concerns before they surface? Wastewater-based epidemiology involves sampling wastewater from various demographic regions and searching for contaminants or markers that may show signals of diseases present. While this concept is still incredibly novel, it has been proven to be effective through its use in tracking the opioid and SARS-COV-2 pandemics. Determinants found in the wastewater can indicate levels of the virus. With highly efficient methods for isolating viral RNA including centrifugation, RNA extraction, and qPCR, the methods could monitor areas of the world concentrated with and most susceptible to certain viruses. Due to the dynamic nature of biomarkers and organic chemicals making them difficult to extract and analyze in water, processes to better read the wastewater for potential indications are ongoing. My objective was to develop methods to examine environmental influences and how they affect neurodegenerative diseases (NDDs) e.g., Amyotrophic Lateral Sclerosis, Alzheimer's Disease, Parkinson's Disease, and others relating to the blood-brain barrier. The unique approach in this lab looks at chronic disorders, applying interdisciplinary areas of study: public health, environmental studies, and chemical analysis. Combined with educating myself on prior research and compiling sample demographic data, my highest priority was to use liquid chromatography-mass spectrometry to identify compounds (AMPA, BMAA, and paraquat) associated with NDDs.

• **BASIS ADVISOR:** Vidya Ananthnarayan • **ON-SITE MENTOR:** Melanie Newell, Ph.D.
• **LOCATION:** Arizona State University

SHREYA G.

DIFFERENCES IN THE PARENTING STRESS INDEX BETWEEN MOTHERS & FATHERS OF KIDS WITH DISABILITIES

SUMMARY: We always worry about children with disabilities, but we never focus on how the parents are dealing with the situation. An equal amount of importance should be placed on both the parents and the children. One area in particular that is poorly understood is the question whether fathers and mothers are affected by their children's disabilities in different ways. Do fathers and mothers experience the same type and level of stress as a result of having a child with a disability? Do they perceive their child's communication skills differently? The present work of the Peter Lab at ASU is based on a clinical trial of a proactive speech and language intervention for infants with classic galactosemia, a metabolic disease that puts children at risk for severe speech and language disorders. The Parenting Stress Index 4 Short Form (PSI 4 SF) measures stress that parents report as feeling themselves, stress that parents estimate felt by their child, and stress that originates from the child and adds to the parents' perceived stress. The Intelligibility in Context Scale questionnaire measures how well the child's speech is understood by different people. The goal is to use these scores to examine the differences between mothers and fathers in regard to estimating how well others understand their child's speech. This research will help us better understand differences in how fathers and mothers report type and magnitude of perceived stress and how they gauge their child's ability to be understood by others.

• **BASIS ADVISOR:** Kayla Karl • **ON-SITE MENTOR:** Beare Peter, Ph.D. • **LOCATION:** Arizona State University

NATHAN H.

DEFINING A ONE CARBON SOURCE IN MITOCHONDRIAL DISORDERS FOCUSING ON MTFMT LEIGH SYNDROME

SUMMARY: This project centers on clarifying the energy consumption pathway associated with a mutation in the mitochondrial methionyl-tRNA formyltransferase (MTFMT) gene, known to cause deficiencies in ATP oxidative phosphorylation (OXPHOS). This mutation presents as Leigh syndrome. Leigh Syndrome (LS) is a progressive neurodegenerative disorder, affecting 1 in 40,000 children in the U.S. Most patients present with symptoms between the ages of three and twelve. The disease course is characterized by a rapid deterioration of cognitive and motor functions, in most cases resulting in death due to respiratory failure. Despite a consistent mutation, discrepancies exist in the presentation of Leigh Syndrome. The primary objective is to elucidate the energy consumption aspect of this pathway, determining the most beneficial energy sources to alleviate stress on mitochondria.

- **BASIS ADVISOR:** Matt Cole • **ON-SITE MENTOR:** Sampathkumar Rangasamy, Ph.D.
- **LOCATION:** Translational Genomics Institute

KESHAV J.
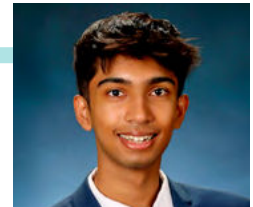
PAINTING WITH BRAIN WAVES

SUMMARY: Emotions are some of the most basic human traits, yet it's increasingly difficult to identify why we experience them. Are they evolutionary boundaries that reward or scare us for our actions? Or are they complete chance adaptations that make humans more human? The thousands of overlapping feelings we can experience blur the already thin lines that hold our happiness separate from our excitement. With the increase in mental health issues, depression cases, and suicide rates in the United States and the world at large, it has become vital for us to understand the underlying reasons behind these statistics and solve the puzzle of emotions. By researching the effective mapping and creation of art using brain states as a measure of emotions we can harness a largely untouched field of health science—art—which holds an advantage over traditional clinical practices in evoking associations that transcend objective thought. Exploring this connection between the scientific representation of emotions and the artistic has the possibility to provide the clinical world with a tool to elucidate our complex feelings. A clearer understanding and representation of emotions can provide necessary insight into patients emotional well-being providing the health care world with a prospect of better tracking patients emotional development and understanding how clinical treatment is specifically affecting patients.

- **BASIS ADVISOR:** Vidya Ananthnarayan • **ON-SITE MENTOR:** Joseph Mager, M.Eng.
- **LOCATION:** Mayo Clinic 3D Innovation Lab

ASHLEY K.

A TRANSDISCIPLINARY APPROACH TO RISK MANAGEMENT IN THE LEGAL FIELD

SUMMARY: The legal field is composed of many uncertainties in comparison with other fields, particularly the aviation field and the medical field. Because many decisions in the legal field tend to be subjective, many agree that the legal field should use ways to significantly lower the risk rate. The aviation field keeps a database of past safety occurrences recorded by a black box to prevent risks in future flights; a standardized method and language are also used by experts to investigate flight accidents. The medical field, specifically in surgical procedures, utilizes "pre-mortem checks" in which the surgeon goes through certain checks before the surgery to make sure that it doesn't go wrong, further preventing risks. These checks can be used as an example to model a process that could mitigate the risks present in the legal field. Through interviews with civil lawyers specializing in bankruptcy and commercial litigation, the most prominent risks that lawyers face will be discovered. The interview findings coupled with literature reviews of risk management processes in the aviation and medical field will help in finding the criteria for mitigating common errors in the legal field, such as client miscommunication, failure to achieve the goal of a civil case, and more.

• **BASIS ADVISOR:** David Johnson, J.D. • **ON-SITE MENTOR:** Scott B. Cohen, J.D. • **LOCATION:** Engelman Berger PC

VANESSA K.
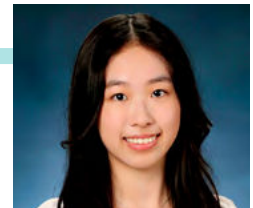
ASSESSING PARASOCIAL RELATIONSHIPS AND THEIR CORRELATION TO IMMIGRANTS' SELF-CONCEPT: A PSYCHOLOGICAL PERSPECTIVE

SUMMARY: As the hallmark of the digital age, social media has revolutionized human interaction. Now, with just a few mouse clicks, users can instantaneously gain access to myriad celebrities, influencers, politicians, and other public figures. When users engage with and emotionally connect to their favorite media personae, a one-sided attachment—termed parasocial relationship—is formed. Conducted in the Culture & Decision Science Network Lab at Arizona State University, this research investigates the correlation between parasocial relationships and individuals' self-concept, with a concentration on the role that racial/ethnic identities play in forming and facilitating those mediated ties. Employing surveys and psychometric tools like the Collective Self-Esteem Scale to evaluate respondents' social identities, the study operationalizes three main questions: (1) How prevalent are parasocial relationships among immigrants or children of immigrants? (2) Do immigrants or children of immigrants tend to have parasocial relationships with those of the same in-group? (3) How do parasocial relationships among immigrants or children of immigrants correlate with their self-concept and other dimensions of their psychological well-being (e.g., acclimatization to a foreign culture)? With the paucity of research examining the parasocial experiences of minority groups, it becomes imperative to explore such phenomena, in hopes of identifying factors or conditions that could promote the mental health of those communities.

• **BASIS ADVISOR:** Anna Mae Almeida, Ph.D. • **ON-SITE MENTOR:** Sau Kwan, Ph.D.
• **LOCATION:** Arizona State University, Department of Psychology

ABIGAIL L.
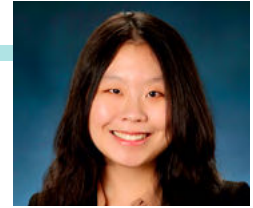
GET UP AND MOVE! EXPLORING MOTIVATIONS BEHIND REDUCING SEDENTARY SCREENTIME

SUMMARY: How often do you find yourself munching on your favorite snack while binging Netflix, or endlessly scrolling through TikTok sprawled out on your bed? Do you wish you could change this lifestyle, but don't know how to go about it? Sedentary screen time (SST) is one of the biggest factors that prevent people from getting the recommended amount of physical activity. This only worsened during the COVID-19 pandemic, and it has had significant impacts on both physical and mental health. SST is associated with obesity and other serious health consequences, such as heart disease, diabetes, and poor sleep, while exposure to negative media through SST is associated with depressive symptoms. In collaboration with the 24 Hour Behaviors Laboratory at the ASU College of Health Solutions, led by Dr. Matthew Buman, Get Up and Move aims to find connections between various motivations and the success in the reduction of SST. Through surveys and health data collected during the lab's StandUPTV study, which implemented different combinations of interventions to monitor SST, this research focuses on determining specific factors—age, gender, goals, etc.—that allowed some participants to have more statistically significant success than others in controlling their screen usage over a period of 16 weeks. Once patterns in motivation and success have been identified, they will be presented through a research poster, which the laboratory can use when presenting their findings for their studies.

- **BASIS ADVISOR:** Patrick Kilmer-Webb • **ON-SITE MENTOR:** Arlene Fernandez
- **LOCATION:** Arizona State University, College of Health Solutions

LIZA L.

NON-RESETTLEMENT OF ANCIENT MAYA INTERIOR AFTER THE TERMINAL CLASSIC PERIOD

SUMMARY: The Maya were one of the most populous and socio-politically complex ancient civilizations. However, after centuries of developing intricate cities, language systems, and trade networks across the Yucatan peninsula, most of the Maya people abandoned their inland cities during the Terminal Classic period (~800–1000 C.E.) due to factors including drought and governmental instability. Historically, large regions that experienced drastic population declines have often seen a resettlement or repopulation, but not the ancient Maya. Despite the sophisticated infrastructure they left behind, they never returned to the Yucatan interior on a large scale, for reasons that have been largely unstudied by scholars. This project addresses potential reasons for the non-return of Maya populations. We will first make pre- and post-Terminal Classic population estimates of the southern, central, and northern Yucatan regions the Maya occupied. Subsequently, through analysis of shifting trade routes, cultural and political changes during the Terminal Classic period, land usage, and economic costs of maintaining Mayan infrastructure, we will determine possible push and pull factors that led the Maya to remain in the coastal cities they migrated to in the Northern Lowlands. Issues ancient societies like the Maya faced span many centuries. A key cause for Maya migration was environmental stress. Given the current state of climate change, it is becoming increasingly important to look to the past for lessons of adaptability and resilience.

- **BASIS ADVISOR:** Chad Carver , Ph.D. • **ON-SITE MENTOR:** Billie Turner II, Ph.D.
- **LOCATION:** Arizona State University, College of Global Futures

PRISHA M.

ANALYZING AND CATEGORIZING HELPLINE TEXTS USING AI

SUMMARY: After volunteering for counseling websites that use surveys to assign hotline texters to counselors, I've noticed that the long multiple-choice surveys often used by these websites can be a barrier to receiving effective counseling. To address this, I'm exploring methods of streamlining the texter-counselor pairing process. By using AI to classify hotline chat messages based on commonly occurring topics in counseling, counselors and texters can be paired based on the texters' needs. Such classification can also be used to quickly communicate information if it needs to be shared due to emergency situations or transfers between counselors. To explore the various topics that hotline calls and text conversations can involve, I am training to become a peer counselor at Teen Lifeline, a mental health hotline for teenagers. During my training, I will discover the main topics often seen in hotline calls and text conversations while gaining a deeper understanding of how text conversations can appropriately be classified to improve the operation of hotlines and counseling websites. I am also working with a psychiatrist to learn how specific messages can be accurately classified. By categorizing hotline text messages with AI, I hope to ensure texters in need receive the most effective counseling possible.

• **BASIS ADVISOR:** Liane Kerkman • **ON-SITE MENTOR:** Mark Williamson • **LOCATION:** Teen Lifeline

VINCENT N.

FUTURE INDICATIONS OF EQUINE AMNION-BASED REGENERATIVE SCIENCE

SUMMARY: Amnion, a crucial element in prenatal development, serves as a protective shield for the developing fetus within the mother's womb and provides a conducive environment through the amniotic fluid. Beyond its protective function, amnion holds immense significance due to its rich source of amniotic materials. These special materials possess remarkable regenerative potential, offering a promising avenue for addressing injuries and illnesses. Amniotic-derived materials also have the potential to facilitate the catalysis of tissue repair, rejuvenating damaged tissues and promoting regeneration, which makes it a valuable resource in the veterinary environment. This presents innumerable lessons to learn about amnion and its regenerative properties. The amnion membrane market, valued at $3.52 billion in 2022 with the veterinary amnion market contributing 30%, is projected to reach $8.5 billion by 2030. This growth reflects the significant interest amnion has garnered due to its properties. In this project, we will analyze the growing potential of amnion, its regenerative capabilities, and future veterinary possibilities. Incorporating comprehensive literature reviews, collaboration with AniCell Biotech, analysis of case studies, and hands-on lab pre-research including and immunohistochemistry, this research hopes to present a better understanding of the true potential of amnion's regenerative properties and its future uses.

• **BASIS ADVISOR:** Suba Rajasekaran • **ON-SITE MENTOR:** Brandon Ames • **LOCATION:** AniCell Biotech

RUHI P.
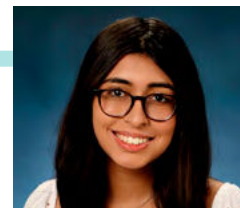
THE INFLUENCE OF DISRUPTED CELLULAR FUNCTION IN CEREBELLAR DENTATE NUCLEI ON DECISION-MAKING IN ADOLESCENT LIFE

SUMMARY: In the neurobiological perspective, adolescence is a critical period in cognitive development where significant improvements in cognitive abilities including decision-making take place. When cerebellar injury and disrupted cellular function occur throughout this critical period, the progression of this development is hindered, thus leading to the lack of stabilization of cognitive ability in adult life. With the SOCIAL Neurobiology Lab at Arizona State University, a joint analysis utilizing machine learning and immunohistochemistry is conducted to assess the effects of disrupted cerebellar function on decision-making in adolescent life with mouse models. Through the deep-learning software SLEAP (Social Leap Estimates Animal Pose), recorded mouse behavior completing touchscreen visual discrimination tasks with two visual stimuli are tracked across each frame to analyze decision-making. Additional data is extracted with Python on the time utilized to complete these visual discrimination tasks and time spent in differentiated behaviors while carrying out the task. Employing immunohistochemistry techniques and microscopy, brain tissue is sectioned to quantify neural activity using the immediate-early gene (IEG), c-Fos in the anterior cingulate cortex, a brain region important for decision-making. IEGs are markers of neural activity and are used to identify the learning processes that take place during neuronal gene expression. As cerebellar abnormalities are commonly associated with autism spectrum disorder (ASD) and cerebellar function is understudied, conducting this research poses significance on the impacts of cerebellar perturbations on higher-order cognitive function, including decision-making, especially in at-risk adolescents with ASD.

> • **BASIS ADVISOR:** Anna Mae Almeida, Ph.D. • **ON-SITE MENTOR:** Jessica Verpeut, Ph.D.
> • **LOCATION:** Arizona State University, SOCIAL Neurobiology Lab

PRANJAL P.

IS THE NEOMA A BETTER SYSTEM FOR TRACE ELEMENTAL ANALYSIS?

SUMMARY: Do you know about the chemical purity of materials in your day-to-day life? Trace elemental analysis can tell you. For around 30 years, the Inductively Coupled Plasma-Mass Spectrometer (ICP-MS) has been gaining favor in laboratories worldwide as the instrument of choice for performing trace metal analysis. With this growing demand and importance of productivity due to instrumental design, newer versions of technology aimed at high-precision isotope ratio analytics are arising such as the Neoma MC-ICP-MS (Multicollector-Inductively Coupled Plasma-Mass Spectrometer) system. The Anbar Lab at Arizona State University has recently upgraded its instrument from the Neptune to the Neoma which will be tested by performing trace metal (isotopic) analysis to prove its greater efficiency and better capability to produce similar if not better results. My role is to aid the team in collecting and analyzing new data of sensitivity, resolving power, and stability using isotope samples of different elements. Then the next step for me is to compare the new data to the old data of the older instrument in order to understand the functioning capability of the new instrument. The long-term goal is to open avenues in scientific research in terms of how much less material could be used to gain accurate and precise results during events of sample limitation and in situations of wanting to preserve priceless objects. By conducting this type of research, the field of geochemistry is advancing using more efficient techniques to obtain high precision isotope ratio analysis of liquid and solid samples.

> • **BASIS ADVISOR:** Alex Harmatuck • **ON-SITE MENTOR:** Ariel Anbar, Ph.D.
> • **LOCATION:** Arizona State University, Anbar Lab

SARINA R.

SAVING OUR SUSTAINABILITY: COUPLING DECARBONIZATION WITH DESALINATION IN WATER PURIFICATION

SUMMARY: How do we know that the water that sustains our lives is clean? Transforming natural water sources in rivers and lakes into the water that comes out of our faucets, water purification involves a complex series of steps. Filtration systems heavily depend on membranes and water movement, which are key determiners of how clean the resulting filtered water will be. By modifying existing technology, this project seeks to develop a membrane capable of removing carbon dioxide (decarbonization) through direct ocean capture during the water desalination process, providing a sustainable mechanism for reducing environmental carbon dioxide to reduce its harmful impacts, such as global warming. Through testing the chemical characteristics of polymer materials used in water purification systems, we can modify the polymer's characteristics at the molecular level to create qualities that are favorable for effective desalination and decarbonization. Working towards developing polymer membranes with advantageous qualities aims to transform our systems and improve current state-of-the-art technology. Ensuring our clean water sources are renewable and safe is an essential step towards saving our sustainability and providing stability for future generations to come.

- **BASIS ADVISOR:** Suba Rajasekaran • **ON-SITE MENTOR:** Matthew Green, Ph.D.
- **LOCATION:** Arizona State University

ACHINTYA S.

EFFECTS OF MULTIPLE SCLEROSIS & PARKINSON'S ON SHORT-TERM COGNITION: A STATISTICAL ANALYSIS

SUMMARY: Senior citizens are one of the most marginalized groups in the U.S. Much of our elderly population has been relegated to nursing homes for their residence, and many families don't have the resources or time to serve as support systems. Now, on top of that, neurological ailments plague them, leaving our elderly worse off both mentally and physically. Most cases of Parkinson's are found in the senior citizen population, and it's estimated that around 1 in 9 have Alzheimer's. Even with lesser-known diseases such as Multiple Sclerosis, around 9% of the elderly population is estimated to have MS. Working with Dr. Peterson, as part of the SCENE ASU program at the Arizona Biomedical Collaborative, we're aiming to conduct statistical analysis of cognitive performance on the California Verbal Learning Test-II. The goal is to parse through specific indicators and analyze improvements in cognition, such as discriminatory capabilities and vocabulary retention. Analyzing those trends, specific information can be determined. Which aspects of cognition are most prone to change and have the most training potential? With those cognitive indicators, can specific motor control functions be improved which are associated with the same neurological pathways as the cognition? If we can bring about even marginally significant results, even though not all neurological ailments will be covered, there will be a larger scientific base as to how we can train cognition. Finally, considering that these ailments primarily affect senior citizens, the elderly population will greatly benefit from any potential results. Also, we will be able to discern the potency and frequency of cognitive training for various ailments.

- **BASIS ADVISOR:** Suba Rajasekaran • **ON-SITE MENTOR:** Daniel Peterson, Ph.D.
- **LOCATION:** Arizona State University, Arizona Biomedical Collaboration

SANDEEP S.

OPTIMIZING ERROR-CORRECTING CODES FOR FAULT-TOLERANT DEEP LEARNING MODELS

SUMMARY: Every day, we see increased applications of artificial intelligence in areas from generating advertisements for consumers to directing rockets through the atmosphere. Some of the most high-impact uses of AI, including autonomous vehicle development and medical diagnoses, involve deep learning models, but these are often plagued by minute errors that can change the course of lives. Because of this limitation, my work in this project is directed towards employing error-correcting codes (such as Hamming or Reed-Solomon Codes and more advanced versions of the two) in mitigating these faults and their implications. The primary portion of this will be in the form of a theoretical analysis on the past usages of such "algorithms" in other fields and the evolving nature of deep learning in general. I intend to continue this work after the termination of my Senior Project and synthesize my findings in an academic research paper. This has the potential to provide a vital starting point for further research on developing more effective versions of these codes to improve outcomes in deep learning and many other quantitative fields.

• **BASIS ADVISOR:** John Russell • **ON-SITE MENTOR:** Tina Lal, Ph.D. • **LOCATION:** Stanford Online High School

SAAHITHI S.

THE IMPACT OF POLITICAL IDEOLOGY ON LEGAL ACTORS IN THE CRIMINAL JUSTICE SYSTEM: ATTORNEYS, JUDGES, AND JURIES

SUMMARY: Attorneys of all classes and calibers are often impacted by their own political leanings in some way; consequently, their casework strategies are typically influenced by them as well. This paper displays surveys and accurate measures of the leanings of tax-benefit attorneys from Engleman-Berger PC. Through observational case studies, it then discusses how these leanings affect each aspect of their casework approach: representation of clients, questioning strategies, and relationships with legal actors. Finally, through studying the attorneys' perceptions of their own ideologies and its effects, the paper analyzes the larger implications of ideologically-impacted casework on society. The expected findings of this project are that ideology has significant implications of heavy bias in attorney casework.

• **BASIS ADVISOR:** Brittany Defoe • **ON-SITE MENTOR:** Scott B. Cohen, J.D. • **LOCATION:** Engelman Berger PC

ANVITA V.

ANALYZING THE EFFECT OF MICROPLASTICS ON NEURODEGENERATIVE DISEASES

SUMMARY: Plastic is everywhere, from the water we drink to the air we breathe. It surrounds us on a daily basis, contaminating our environment and ecosystems. Oftentimes, our body systems can be exposed to microplastics and nanoplastics through consumption and inhalation. So, how can a chronic exposure of plastics be related to neurodegenerative diseases? Using liquid chromatography-mass spectrometry and MNP (micro/nano-plastic) depolymerization, we identify microplastics in the olfactory bulb of the brain, which is currently being studied for pathology of neurodegeneration and neurodegenerative diseases (NDDs). By quantifying microplastics in the olfactory bulb tissue, we demonstrate the ability of plastics to cross the blood brain barrier and enable us to study the association between microplastic concentration and NDDs. My assistance will be in collecting, analyzing, and computing the data as well as helping out with the different lab procedures being done by the lab team. The goal of the research is to further understand how microplastics can increase risk for different neurodegenerative diseases and the implications it has for our public health and environment. The research will eventually help us see how this knowledge can potentially be used to find cures or diminish the symptoms and number of cases of these diseases. The ultimate goal is to bring more attention and awareness to the harmful nature of plastics in our environment and begin more efforts to reduce the amount of plastic present in our society.

- **BASIS ADVISOR:** Patricia Pearson, Ph.D. • **ON-SITE MENTOR:** Melanie Newell, Ph.D.
- **LOCATION:** Arizona State University, Environmental Health Engineering

# BASIS Chandler | SENIOR RESEARCH PROJECTS

HARSHIL A.

ANALYZING THE EFFECT OF MID-CIRCUIT MEASUREMENT (MCM) ON SPECTATOR QUBITS

SUMMARY: Mid-Circuit Measurements (MCMs) are a key component in many quantum information algorithms. As such, ways to characterize their performance are of great interest. Specifically, it is important to determine what impact MCM has on nearby, unmeasured, spectator qubits. Here, I present a novel benchmarking analysis consisting of a variation of the Interleaved Randomized Benchmarking Technique. I use this method to evaluate MCM-induced spectator qubit error on various qubits inside IBM's quantum computer "ibm_oslo". I then examine the effect of qubit position on this error, test if IBM's widely-used quantum simulators account for this error, see how this error varies across different quantum computers, and posit potential causes of this error. This project has far-reaching implications as it helps us better understand a gate that will be integral to the advancement of quantum computing.

• **BASIS ADVISOR:** Travis May, Ph.D. • **ON-SITE MENTOR:** Houlong Zhuang, Ph.D.
• **LOCATION:** Arizona State University

OJAS C.
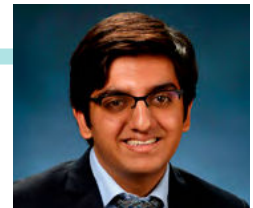
SHOOTING THROUGH THE TEXT: UNCOVERING SENTIMENTS IN CONGRESSIONAL GUN LEGISLATION

SUMMARY: Have you ever wondered about the power of words in shaping public opinion on contentious issues like gun control? Perhaps you hadn't considered their impact at all. My project delves into the emotional and rhetorical dynamics of U.S. Congressional bills on gun issues, spanning from the 107th to the 117th sessions (2001–2023). We aim to strip back the layers of legislative language, uncovering how the debate on gun control and rights is framed and its potential sway over societal attitudes. At the ASU Data Mining and Reinforcement Learning Lab under the expert guidance of Professor Hua Wei, I work on projects that focus on sim-to-real transfer and human-AI collaboration, specifically in optimizing traffic signal control through advanced reinforcement learning techniques. This experience sharpens my ability to navigate complex data and apply machine learning models, skills I use to dissect and analyze the sentiment of legislative texts in my own project on Congressional gun legislation. As we dissect the emotional tones and persuasive strategies within these texts, we're doing more than scrutinizing laws; we're revealing the narratives that fuel national discourse and mold public perception. The ultimate goal? To offer a lens through which we can better understand the polarized landscape of gun legislation, providing insights that could reshape how policies are communicated and perceived. Join us in this exploration of linguistic power, where every word in a bill carries the weight of conviction and the potential to shift the tides of public opinion!

• **BASIS ADVISOR:** Travis May, Ph.D. • **ON-SITE MENTOR:** Hua Wei, Ph.D. • **LOCATION:** Arizona State University

ARJUN C.

MEASURING THE EFFICACY OF HEXAGONAL BORON NITRIDE AS THE INSULATING LAYER IN TRANSISTORS

SUMMARY: Since their inception in the 1940s, field effect transistors (FETs) have grown to become the transistor of choice for most digital integrated circuits. Within the FET family, metal-oxide-semiconductor FETs (MOSFETs) are the most prevalent type of FETs used in electronic devices today. They consist of a metal gate separated from the semiconductor channel by an insulating oxide layer. Presently, Silicon Dioxide ($SiO2$) is the insulating layer of choice for many reasons, however, as silicon technologies reach their maximum efficiency, the search for newer more capable materials has begun. One such insulator which has shown much promise is hexagonal Boron Nitride (hBN). Though not inherently compatible with other silicon components, its thermal stability, wide bandgap, and higher dielectric constant will theoretically improve power efficiency and limit leakage current within the electron channel. In this paper, we will integrate a few-layered sheet of hBN into a device and measure its power output, chemical stability, leakage current, and lifespan within a device and examine its overall efficiency as an insulating layer within a FET.

• **BASIS ADVISOR:** Travis May, Ph.D. • **ON-SITE MENTOR:** Ivan Sanchez Esqueda, Ph.D.
• **LOCATION:** Arizona State University

RITWIK J.

WHAT ARE POTENTIAL FACTORS INFLUENCING PARENTS' PERCEPTIONS OF CHATGPT USE IN CLASSROOMS?

SUMMARY: Since entering the spotlight in late 2022, ChatGPT has taken the field of education by storm. Researchers have waxed eloquent about the benefits GPT could bring when integrated into the field, from providing personalized feedback to students to helping teachers create course materials. Despite its immense potential, many school districts nationwide don't have a uniform policy regarding the tool. As school districts continue to traverse relatively new territory, it is vital to understand parents' perceptions of ChatGPT being integrated into the classroom. This is because parents play a key role in encouraging their children to utilize educational technologies. However, there is little literature available that looks into these perspectives and potential factors that may influence them. To address this gap, my project consists of distributing a questionnaire with Likert scale and open-ended questions to 6–12 BASIS Charter School parents. The questionnaire will be based on a modified version of the Technology Acceptance Model, a framework that has been extensively used to understand people's attitudes toward technology. Parents will answer questions such as those about their knowledge of ChatGPT and their support of GPT's integration in specific academic contexts. With these results, parents' overall perception of GPT will be identified, and statistical methods will be employed to correlate potential influential factors to these perceptions. These factors would help inform school districts about how to craft and introduce GPT-related policies to students' parents.

• **BASIS ADVISOR:** Travis May, Ph.D. • **ON-SITE MENTOR:** Punya Mishra • **LOCATION:** Arizona State University

LILLIAN L.

INVESTIGATING THE LIMITATIONS OF ONLINE TELEMEDICAL APPOINTMENTS ACROSS COMMON HEALTHCARE

SUMMARY: With the current advent of telemedicine, various research has been done on its benefits and limitations. Overall, telemedicine is currently a common tool being used across the world to increase accessibility to healthcare. Despite this, there have been some limitations on the effectiveness of healthcare, such as the weakening of the patient-provider relationship or technology costs/difficulties. Although many research studies have addressed most of telemedicine's benefits and limitations, very few specify whether the limitations of telemedicine change based on which specialty utilizes it. This begs the question: To what extent is telemedicine effective across different healthcare specialties? In this study, the effectiveness of telemedicine across the most common specialty clinics: primary care, dermatology, psychiatry, cardiology, and otolaryngology (ENT) will be measured through surveys of healthcare providers. The study is designed to better understand how telemedicine can be advanced in areas that require it and to better understand the limitations of telemedicine for the medical field. With this information, further understanding can be made about how important a role telemedicine plays within the healthcare field, especially as it continues to advance and improve. By knowing which specialty clinics benefit or do not benefit greatly from telemedicine, possible work can be done to implement improved telemedicine services across those specific clinics.

• **BASIS ADVISOR:** Travis May, Ph.D. • **ON-SITE MENTOR:** Phung Nguyen, DNP • **LOCATION:** Fountains Family Care

GOPIKISOR S.

THE INFLUENCE OF INA'S PROPAGANDA ON CONTEMPORARY INDIAN POLITICAL IDEOLOGY AND STRATEGY

SUMMARY: While there is extensive research on the Indian National Army's (INA) role in India's independence and its impact on national identity, the influence of INA propaganda on the ideologies and strategies used in contemporary Indian politics remains under explored. This research aims to bridge this gap by first identifying and analyzing themes in INA propaganda, then tracing these themes in contemporary political discourse across various parties such as the Communist Party of India (CPI), Bharatiya Janata Party (BJP), and the Indian Congress. Through a detailed examination of primary and secondary sources from the INA period and a rigorous analysis of modern political speeches, writings, and news, this study seeks to provide a comprehensive understanding of how historical narratives continue to shape political ideologies and strategies today, emphasizing the significance of inter-party comparisons in understanding the legacy of INA's influence on India's political landscape.

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• **LOCATION:** Arizona State University, News/Co Lab

The teachers, administrators, staff, and executive leadership of the BASIS Charter Schools network **commend all of our seniors for their perseverance** in their research, and for their hard work throughout their BASIS Charter School journey. We give **our most heartfelt congratulations** to them for their achievements thus far, and these projects are only the beginning!

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