THE MCNAIR SUMMER RESEARCH EXPERIENCE VIRTUAL

Symposium

AUGUST

04

FRIDAY

10AM-2PM

2023

McNair Scholars Program
UNIVERSITY OF WISCONSIN–MADISON

Division of Diversity, Equity
& Educational Achievement
UNIVERSITY OF WISCONSIN–MADISON

ABOUT THE
MCNAIR SCHOLARS PROGRAM

The Ronald E. McNair Post-Baccalaureate Scholars Program is a federally and nationally recognized Federal TRIO program that prepares first-generation, low-income college students and students from groups underrepresented in graduate education for doctoral study. The Department of Education funded its first McNair program in 1989, while UW Madison's program was funded in 1995. As of 2023, there are 206 McNair Scholars Program nationwide, including Puerto Rico. The McNair Scholars Program at UW-Madison benefits from joint sponsorship of the Division of Diversity, Equity, and Educational Achievement (DDEEA) and a federal TRIO grant from the U.S. Department of Education. Some McNair programs focus specifically on social sciences, others focus on STEM students, and some may have a combination of students from different disciplines. Since UW-Madison ranks among the top 10 research universities in the nation, we strive to serve a wide range of disciplines and enroll approximately 50% of STEM majors in each cohort. The UW-Madison Program is funded through Fall 2028 to serve at least 28 scholars annually.

PROGRAM AGENDA

10:00 AM: Opening Session
(See Your Registration Email from Zoom link)

Welcome: Dr. Audra Hernández, Director
Student Reflection Speeches:
Manal Hasan & Loukia Agoudemos
MSRE Slide Show
Closing

Session 1: 10:30–11:45 AM
(click moderator for Zoom link)

SSH Session - Moderator CJ Greer
Naoshi Johnson
Dajonae Bradley
Liliana Chavez

STEM Session - Moderator Audra Hernández
Faiza Ahmed
Amaya Stanley
Fernando Zacuhua
Mushtaq Ali

Session 2: 12:45-2:00 PM
(click moderator for Zoom link)

SSH Session - Moderator Tiffany Vanphravong
Canaan Bracey
Manal Hasan
Madeleine Allen

STEM Session- Moderator Cynthia-mapenzi Simekha
Laura Arroyo
Loukia Agoudemos
Vanessa Bello Ruiz
Maiyia Vang

ABSTRACTS

Loukia L. Agoudemos
"Engineering Extracellular Matrix-Based Platforms to Model Hypoxic Aortic Valves"
Mentors: Ashley J Scott, Dr. Kristyn S. Masters

Calcific Aortic Valve Disease (CAVD) affects 2.5 million Americans and is characterized by fibrocalcific remodeling of the aortic valve extracellular matrix (ECM). Thickened diseased aortic valve ECM hinders adequate oxygen diffusion to the aortic valve interstitial cells (VICs), creating hypoxic conditions. Currently, little is known about the role hypoxia plays in CAVD progression or whether it contributes to biological sex differences seen in CAVD. We have created gelatin-based scaffolds with embedded aortic valve interstitial cells (VICs) that are 0.6 mm, 1.4 mm, or 2.4 mm thick in order to mimic native valvular thickening and achieve a range of oxygen gradients. To evaluate hypoxia in our scaffolds, we measured levels of angiogenic factors, expression of genes that are transcriptionally regulated by hypoxia, and expression of prolyl hydroxylases, which are regulators of the hypoxia response. We found that VEGF secretion increased with hydrogel thickness. Also, male VICs secreted more VEGF than females. CCN2 is transcriptionally silenced in hypoxia and we found decreased expression of CCN2 in VICs seeded in hydrogels compared to VICs seeded using traditional, 2-dimensional cell culture techniques. GLUT1 is transcriptionally activated by hypoxia, and we found increased expression of GLUT1 in VICs seeded in hydrogels. Prolyl hydroxylase expression was decreased in VICs seeded in hydrogels. These combined data indicate that scaffolds with varied thickness were effective in creating hypoxic conditions. Further, male VICs experience more hypoxia than females, which may contribute to CAVD sex differences.

Faiza Ahmed
"The Use of Machine Learning to Enhance Early Detection and Prevention of Cardiovascular Disease"
Mentor: Dr. Jessi Cisewski-Kehe

Cardiovascular disease (CVD) is a global health concern, emphasizing the need for effective early identification and prevention strategies. Traditional risk assessment models often fail to capture the complexity and interdependence of various risk factors associated with CVD. This study aims to address the existing knowledge gap by employing machine learning techniques, specifically persistence homology, to reliably identify patterns and risk variables linked to CVD. In this study, we look at whether utilizing persistent homology, a topological data analysis method, can uncover patterns and risk factors for cardiovascular disease in huge datasets. Our hypothesis suggests that incorporating persistence diagrams into the classification models can enhance their performance and provide additional information for characterizing group differences. The study aims to bridge the current gap in precise and effective approaches for recognizing and identifying patterns and risk factors associated with cardiovascular disease at an early stage. By leveraging machine learning algorithms, we strive to improve CVD detection and enable proactive preventative measures. The implications of this study are substantial, as developing more accurate and efficient methods for detecting cardiovascular disease can lead to improved patient outcomes, saving lives, and reducing the burden on healthcare systems. Developing more accurate and efficient methods for detecting cardiovascular disease can lead to improved patient outcomes, saving lives, and reducing the burden on healthcare systems. Furthermore, the use of machine learning in healthcare contributes to the expanding sector, paving the way for transformative advances in medical diagnosis and treatment approaches. This research adds to reducing the knowledge gap and improving our understanding of effective techniques for maintaining cardiovascular health by addressing the need for early detection and prevention of CVD.

ABSTRACTS

Mushtaq Ali
"Investigating Gene Function for Improved Drought and Nitrogen Deficiency Tolerance in Model Plant"
Mentors: Dr. Burcu Alptekin and Dr. Jean Ané Michael

Nitrogen and water are essential factors impacting plant growth, and they lack marginal soils. The main goal of our project is to investigate multiple genes' role in improving drought and nitrogen deficiency tolerance in model plants and cereals. As we all know drought-like conditions can hinder the photosynthesis process, which can cause agriculture to whither and ultimately die. Agriculture is the main source of livelihood for many individuals, so what gene can we modify to assist plants in surviving in drought-like conditions? The focus of my presentation will be the ATBBX19 gene. We studied the ATBBX19 gene in both nitrogen and water response in our computational studies by using the following expression lines, OE44(overexpression of the gene), Ri323(under expression of the gene), and COLO(our control type).In our preliminary computational studies, these lines were found to be responsive to both nitrogen and water. Furthermore, initial experiments suggest that the ATBBX19 gene plays an important role in plant response to water stress. To realize this aim, I worked on the following objectives: Phenotyping several genes for biomass and survival under drought, nitrogen-deficient conditions, and generation of overexpression lines for several Arabidopsis genes (screening for resistance against the antibiotic, RNA extraction + PCR for controlling gene expression). Upon using these techniques I noticed that my first batch of results for the nitrogen and water resistance screening had failed on the control plants, causing me to restart the experiment and plate a new batch of seeds. My second experiment was successful, meaning that the control plants generated an adequate response to the four different screening conditions (N+W+, N-W+, N+W-, N-W-). Lastly, the results I generated suggested that OE44 is hyperresponsive to the presence of water whereas Ri323 is not responding to water in terms of shoot biomass. Meaning that whether or not water was present the Ri323 plants were able to grow the same.

Madeleine R. Allen
"Effective Inclusion of Family Caregivers into the Mental Healthcare Team for Older Veterans with Memory Loss: Clinician Perspectives"
Mentor: Dr. Mary F. Wyman

Family caregivers assist older adults with memory loss but may need to be more effectively engaged in the healthcare team. Caregiver inclusion may help address known disparities in mental health care access and quality for these patients who experience high rates of comorbid mental health (MH) disorders. We sought to identify facilitators and barriers to effective caregiver inclusion for older patients with dementia and comorbid mental health concerns. Nine multidisciplinary MH clinicians (psychiatry, social work, psychology, and clinical pharmacy) completed individual, 30-minute, semi-structured interviews on working with family caregivers of older patients in a MH service at a large Veterans Affairs medical center. Content analysis using the Nvivo qualitative software program will guide the identification of factors relevant to inclusive care in this setting. An initial team-based rapid content analysis resulted in a structure codebook with 32 codes reflecting patient, caregiver, and provider factors that impact caregiver involvement in the MH setting. Codes include identifying and developing rapport with the caregiver and good communication between the patient, caregiver, and provider. Increasing caregiver inclusion for older Veterans [persons] with memory loss is critical to meet this growing patient population's healthcare needs and reduce MH care disparities for older Veterans and their families. Future steps include interviews with patients and caregivers. Ultimately, our findings will go towards developing clinician guidelines and training to support more effective caregiver involvement in the healthcare setting.

ABSTRACTS

Laura Arroyo
"Persistence of Zika virus-specific antibodies in infants using translational macaque model"
Mentors: Dr. Emma Mohr

In-utero Zika virus (ZIKV) infection is a significant public health threat for infants as it can be vertically transmitted from mother to fetus resulting in several health problems including physical and neurodevelopmental deficits. Current diagnostic approaches for confirming in-utero ZIKV infection rely on detection of ZIKV RNA or ZIKV-specific IgM antibodies in infants after birth. These biomolecules are inherently transient making it difficult to reliably confirm in-utero infection, especially in the case of maternal infections that happen early in gestation. ZIKV-specific IgG detection in infants after 12 months of age suggests the development of their transferred maternal IgG, which is suggestive of in-utero infection. Previously, we have shown that ZIKV-infection of pregnant macaques results in differential maternal infection control, like what is seen in human cases. We hypothesize that poor maternal infection control in pregnant macques will result in greater rates of fetal infection causing ZIKV-specific IgG detection in infant samples for more than 12 months. We will measure ZIKV-specific IgG titers in ZIKV-exposed infant serum samples using a whole virion ELISA at 1,3,6,12,18,24,30, and 36 months of age and determine association with maternal virologic control. Further investigation and research may lead to enhanced diagnostic methods that allow for earlier detection and timely interventions in infants, improving their quality of life.

Canaan Bracey
"Psychological and Physiological Effects of Different Objects of Breath Meditation"
Mentor: Dr. Matthew Hirshberg

The effects of different objects of attention in the same style of practice have not yet been studied. Breath awareness is a foundation technique in secular mindfulness-based interventions and many meditation traditions. Some research has compared the effects of breath meditation to other forms of meditation practice, but no research has yet examined whether the location in the body attention to the breath is placed has detectable effects on the practitioner's subjective experience and physiology. This study will test whether attention placed on the breath in the belly versus the nostrils (two classical anchors for the breath) result in differences in subjective experience, respiration or heart rate. I will utilize a within-subjects cross-over design. Each participant will be randomly assigned to focus on either the belly or nostrils for 3-5 minutes of practice (final duration determined following piloting). After a 10-minute period of structured rest, the participant will then focus on the other breath anchor. For five minutes before and continuously throughout the experiment, I will collect respiration and heart rate using Bluetooth belts, ECG electrodes and the BIOPAC system. Participants will complete a battery of selfreports at baseline (e.g., affect, mindfulness, self-regulation, meta-awareness) and repeat a smaller battery of self-reports immediately after the first session, before the second session, and after the second session. Results may also allow future research to identify individual differences that predict differential response patterns. Ultimately, this learning may support personalized introductory paths to meditation practice that are best suited to each individual

ABSTRACTS

Dajonae Bradley
"Capacity for PCORI/ CER & Improved Mental Healthcare in the Prison Setting"
Mentor: Dr. Mike Koenigs

Over one-third of the U.S prison population has been diagnosed with a mental illness, and the literature shows that incarcerated individuals experience many different mental healthcare disparities (Community Policing Dispatch, 2022). Our project prioritizes community engagement while investigating mental healthcare in prison settings. We aim to identify what mental healthcare promoters and barriers are presented in prisons and what resources can be implemented to foster better care. In order to capture the perspective of formerly incarcerated individuals regarding mental healthcare, we held six meetings with a stakeholder advisory group and the research team. Each meeting included three facilitators, two of which were formerly incarcerated, three members of the research team, and five other formerly incarcerated individuals. The advisory group feedback suggests that currently incarcerated individuals want additional psychotherapy resources with less reliance on pharmacological treatments, improved intake assessments, and further mental health education. Some factors that would decrease barriers to accessing care are strengthening the relationships between prison staff and incarcerated individuals and reducing burnout experienced by qualified mental healthcare providers. Considering this is one of the first studies to prioritize the perspective of formery incarcerated individuals, merging what is known from previous literature with our findings to create a holistic understanding of the current state of mental healthcare in prisons may be challenging, Further research will allow us to understand why practices often used in prison settings contribute to inadequate care, how the lack of support produces additional negative consequences, and how treatments and programs can be improved.

Liliana Chavez
"Black, Indigenous, People of Color (BIPOC) Parents' Desires for Their Children's Education"
Mentor: Dr. Linn Posey-Maddox

Numerous studies point to linkages between parents and caregivers' aspirations and a student's academic performance, highlighting the importance of understanding these aspirations. There is a lack of knowledge about the desires that Black, Indigenous, and People of Color (BIPOC) parents have for their children's education beyond a narrow focus on schooling and academic achievement. Using a broad lens to understand parent's aspirations is essential, as it may reveal culturally relevant aspirations outside formal school walls. This study examines BIPOC mother's desires for their children's education, learning, or development during their Prek-12 education and how they engage in and support their education based on these desires. The data for this project is a subset of a more extensive qualitative study of educational support for BIPOC mothers during the 2020-2021 school year. This papers explicitly analyzes semi-structured interviewers with 15 mothers of children enrolled in a midwestern school district marked by racial opportunity gaps. Preliminary data analysis suggests that BIPOC mothers maintained intense desires for their children to have good formal education opportunities and desire for their children to learn beyond the school's curriculum in ways that develop their children holistically. This project highlights BIPOC parent's desires for children's education beyond formal schooling, allowing for a better understanding of their overall educational aspirations. Understanding parents' educational desires for and engagement in their children' education is important as it can inform family-school relationships and policies.

ABSTRACTS

Manal Hasan
"Increasing Underrepresented Students' Critical Consciousness: A Career Wellness Pre-Post Intervention"
Mentor: Dr. Pa Her

This quantitative study investigates the effectiveness of the "Tuned in to Strive Out Program" a career wellness intervention, for underrepresented college students. The Tuned in to Strive Out program is a 5-week workshop series intended to guide students to preserve a stronger sense of wellness and self-determination in their vocational development (Center for Research on College-Workforce Transitions, 2023). The intervention is grounded in career development theories and a Radical Healing framework. The Radical Healing framework consists of five collectivism, and strength and resistance (French et al. 202; Tuned In Labs, 2023). This study will used a pre-and post-survey test design to assess the difference in critical consciousness of student participants after the completion of the intervention. Students will complete a pre-and post-survey test, which includes demographic questions and a scale on critical consciousness. The study hypothesizes that completing the intervention will increase student's critical consciousness, which is supported by previous literature (Diemer, 2016; Cadenas, 2019, 2022; French et. al, 2020; Uriostegui et al., 2020). We will used repeated measures analyses of variance to determine pre-and post-intervention differences. The literature review and rationale for the study comprise this presentation, as data collection will begin Fall 2023.

Naoshi Johnson
"The Causes of Vaccine Hesitancy in Black Americans and Recommendations"
Mentor: Dr. Susan Passmore

During the Covid-19 pandemic, Black Americans experienced higher rates of vaccine hesitancy and lower rates of vaccine uptake when compared to White Americans. Medical mistrust due to historical and contemporary adverse experiences with the medical system was commonly seen as one of the reasons behind these observed disparities in the Black community. My research question centers around the causes of vaccine hesitancy among Black Americans, and potential recommendations to alleviate the issue. I conducted an extensive review of the literature surrounding the causes of vaccine hesitancy in Black Americans on research databases (PubMed) as well as the recommendations outlined by researchers. With my inquiry, I aimed to assist in reshaping the conversation of vaccine hesitancy among Black Americans from being overly critical of the Black community to one that is more understanding and empathetic.

ABSTRACTS

Amaya Stanley
"Modeling the Blood Brain Barrier: The Role of NOTCH3"
Mentors: Dr. Hope Holt, Dr. Sean Palecek

The Blood Brain Barrier (BBB) provides the Central Nervous System (CNS) with blood vessels that function by tightly regulating movement of molecules between blood and the brain. In this study, we explore if NOTCH3 signaling in hPSC derived neural crest can direct differentiation of brain mural cells with better transcriptional gene expression that can be verified with quantitative polymerase chain reaction (qPCR). Vascular smooth muscle cells, also called mural cells, regulate development of the BBB. The differentiation process of mural cells derived from neural crest stem cells (NCSC) is not well understood. Compared to in vivo samples, in vitro models of human brain mural cells show reduced expression in important mural cell genes, including NOTCH3. When hPSC derived Neural Crest are treated with Lentivirus that includes Notch3 intracellular domain (N3ICD) this leads to fast differentiation of cells that have brain mural cell properties. N3ICD expression can be known by expression of green fluorescent protein (GFP) that is also in the Lentivirus. Imaging of cells to verify the expression of GFP and results of qPCR demonstrates NOTCH3 signaling in hPSC derived neural crest cells.

Vanessa Bello Ruiz
"Developing New Antennas for Future Radio Astronomy measurements of Neutral Hydrogen Gas"
Mentor: Dr. Peter Timbie

Cross-Coupling occurs as the signal is reflected by an antenna and is picked by another antenna. Currently, there is a gap in reducing the cross-couponing between telescopes. The Tianlai Dish Pathfinder Array's purpose is to make a 21cm intensity mapping survey. The 21 cm intensity mapping method looks at the redshifted 21 cm lined emitted by neutral hydrogen gas to learn about the formation and structure of the first objects during the cosmic dawn and Epoch of Reionization along with other cosmological questions. An array of antennas is used instead of a single one because they are more sensitive to detecting and collecting signals. Using a single antenna would mean that it would mean that it would need to be consistently repositioned to scan the sky to make to make maps. Having multiple antennas means they can look in multiple directions simultaneously and have a larger portion of sky to compare data which saves time to compared to a single antenna. However, with an array of antennas cross-coupling along with creating a collar around the antenna to reduce the cross-coupling with creating miniature models to fit and test the collars. There have been difficulties with building the antenna and having cables fall out however this has been addressed by changing the order in which parts are placed. Currently, we have two miniature models to which we are measuring the antenna reflection coefficient to compare to the simulations and will soon be able to measure the coupling between both antenna through the VNA.

ABSTRACTS

Maiyia Vang
"Examination of SBT mRNA and/or Protein Level in the ileum of MGAT2 KO Mice and its Wild Type of Control"
Mentor: Dr. Mei-i Yen

Mice with a deficiency of the intestinal enzyme monoacylglycerol acyltransferase 2 (MGAT2 KO) are protected from metabolic disorders induced by high-fat feeding. Our lab further showed that these protective effects are due to elevated bile acid levels in their plasma, likely resulting from enhanced bile acid reabsorption in the ileum through the apical sodium-dependent bile acid transporter (ASBT). the ASBT transporter, mainly expressed in the ileum, reabsorbed most of secreted bile acid back into the portal vein to the liver. My study this summer aimed to examine whether MGAT2 KO mice have a higher expression of ASBT at the mRNA and/or protein level than their wild-type (WT) controls. I isolated the jejunum (control) and ileum tissues from WT and MGAT2 KO mice to examine ASBT at the protein level utilizing Western Blot with anti-ASBT antibodies and at the mRNA level using qPCR. I found that the relative expression of ASBT proteins in the ileum of MGAT2 KO mice is trending higher. However, ASBT protein expression were not detected in the jejunum. The ASBT mRNA levl in the ileum of MGAT2 KO is trending higher but does not reach statistical significance. The next step is to repeat the experiment with more samples, including MGAT2 KO mice and WT with low and high bile acid levels in plasma. My study may be significant to understanding the factors that protect MGAT2 KO mice from obesity and associated metabolic disorders.

Fernando Zacahua
"Testing SHY: The Synaptic Homeostasis Hypothesis of Sleep"
Mentor: Dr. Chiara Cirelli

The Synaptic Homeostasis (SHY) introduced by Drs. Cirelli and Tononi provide an explanation on how we are able to consolidate memories after sleep. During wake, neurons are excited and interact with other neurons through trillions of synapses, causing these become weakened. It is hypothesized that those synapses that are weakened are those that are unimportant compared to those that are significant, thus helping to consolidate memories. The weakening of many synapses during sleep also has other key advantages, including saving energy and avoiding synaptic saturation, thus allowing new learning the next day. The general goal of our investigation is to test the main claim of SHY that most synapses get stronger during wake and weaken during sleep. In my project I am analyzing the structural evidence to support SHY, specifically studying how astrocyte-synaptic interactions change between sleep and wake. With the use of the serial block-face scanning electron microscope, I will learn how to measure synapse size in the mouse striatum, a region involved in motor learning that continues to be highly plastic even in adulthood.

THANK YOU

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