

# Departments of Neurosciences and Psychiatry 2024 Research Symposium

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The University of Toledo Departments of Neurosciences Psychiatry first annual research symposium represents the up-and-coming innovative research for mental healthcare and medicine taking place within our community, as well as the determination to push the field forward of Translation and Basic Neuroscience. The students, scientists, faculty, physicians, and clinicians at UT are working tirelessly to innovatively push the boundaries of translational and basic neurosciences. The annual research symposium serves as testament of our commitment to explore the scientific unknown and radically change the lives of those who live with mental illness. Working together, we have the potential to become international leaders integrating cutting-edge approaches into behavioral health treatment, pushing the boundaries for this field in medicine.

During this symposium, Dr. Scott Pappada, an Associate Professor and Director of Research for the Department of Anesthesiology, gave an excellent keynote speech on the use of wearable

technology that can be considered as a biomarker for psychiatric disorders. It can, for instance, help avoid relapse in the domain of addiction recovery. Dr. Pappada utilizes neural networks and machine learning analysis to predict future behaviors or emotional states based on physiological signals.

Dr. Wei Niu, an Assistant Professor in the Department of Biological Sciences, gave the 2nd keynote, describing her developmental neuroscience research focused on understanding the molecular biology of autism spectrum disorder. Dr. Niu uses Stem Cells and CRISPR/CAS9 genome editing to test for different gene variants associated with ASD that affect cortical development.

Finally, Dr. Noah Philip, a Professor of Psychiatry and Human Behavior at Brown University, gave the primary keynote lecture, focused on using Transcranial Magnetic Stimulation (TMS) to treat Depression and PTSD. Dr. Phillip’s outstanding presentation was well received and a highlight of the symposium. While all the research presented

here has a general “Neuroscience” and “Mental Health” theme, each project is highly interdisciplinary, ranging from molecular and cell culture work to clinical behavioral research.

We believe that by taking a multimodal approach towards understanding neurological and behavioral disorders, we can concentrate on defining behavioral characteristics, developing more precise diagnostic tests, and creating more effective treatment paradigms. Taken together, this research will be used to optimize medical care by utilizing scientific advances. The following topics shall represent the individual efforts of our learners and faculty pushing the Translational and Basic Neuroscience and Mental Health Care frontier forward.

### Neuroinformatics

Bioinformatics research at the molecular level is being conducted across several laboratories within the Neuroscience and Psychiatry Departments to examine molecular pathologies and understand the mechanisms of evolutionary biology.

Within the Fedorov Lab, Emily Crossley is conducting research on ultra-conserved non-coding element (UNCES) sequences that have been conserved in humans for millions of years and are shared between other species of animals such as chickens. Interestingly, the chickens' UNCE areas have an excess of GpC but a decrease in GpG and CpC in comparison to the human genome. These different dinucleotide arrangements have led to disincursive DNA structures that may contribute to unique DNA structure. This research helps examine the human origin and expand through an evolutionary biology lens and helps understand our place within the tree of life.

The McCullumsmith (Smith) Lab uses a variety of omics approaches to study the pathophysiology of cognitive disorders to develop new treatments

and diagnostics. Ali Imani, a PhD student, is using active kinomics to compare the pathophysiology of Alzheimer's and Schizophrenia. Mark Houdi is using Transcriptomics to study differential gene expression of Neurofibromatosis and 2 nerve tumors to develop new precise treatment methods. Hunter Edy, another PhD student, is using Bayesian Networks to understand the interplay of Psychiatric Illness and Cancers. William Ryan's work is focused on building tools to enhance multi-omic integration and identifying complex trends in datasets.

The O'Donovan lab is using proteomics to carefully access the complex interplay of proteins of diseases to develop robust biomarkers and treatments. Smita Sahay, a PhD student is working on data mining of the MINIC-IV database to identify differentially expressed proteins in Alzheimer's and control patients and successfully identified potential diagnostics biomarkers.

The Burkett lab's Jenn Nyugen is using multiomics to understand how pesticides affect neurodevelopment. On the molecular level, genes and pathways associated with circadian rhythm, synaptic growth, and folate metabolism have been shown to be affected.

### Cellular and Molecular Neuroscience

Cellular and Molecular Neuroscience research has been conducted to gain a deeper understanding of disease pathologies and biochemical mechanisms that take place within nerve cells.

The Hill lab is doing research on the synthesis of insulin and interplay of this pathology on diabetes. Marziyeh Jahromi is studying Insulin FOXO pathway in hypothalamic astrocytes to better understand prostaglandins synthesis. Understanding the kinomics and cell signaling pathways within this pathway will help develop precise treatment for diabetes and several types of cancers.

Anantharam lab is using electrophysiology to understand the neural cellular response to different extracellular conditions. Nicki Bell is studying PACAP chromaffin cells to gain a better understanding of how neuroendocrine stress response affects exocytosis. Understanding how these cells react to different conditions will allow us to develop a more comprehensive understanding of pathologies associated with neural cells.

Dr. Burkett's lab is studying the exposure to diverse types of toxins that can impair neurodevelopment, even at perceptively safe levels for adults such as with Pyrethroid Pesticide. Nilanjana Chakrabarti Saferin and Ibrahim Haseeb, are studying how exposing rats and prairie voles to pyrethroid pesticide or similar chemicals, can lead to decrease cognitive performance on different behavioral tests, increased repetitive behaviors, and attention issues. This research shows us how ecotoxicity can affect us all.

### **Translational and Animal Behavioral Research**

Research using animal models is being used to study behavioral and phenotypical pathologies of diverse types of psychiatric diseases and to develop new treatment options for diseases.

The Andari lab is using the prairie vole model to generate new behavioral assays that can measure social learning in this translational model. More specifically, Dr. Andari and her PhD student Daniella Gamboa Pabon developed a social transmission of negative valence task that seeks to measure freezing levels in socially conditioned observers following the observation of their stressed partner. The Andari lab is also exploring new brain areas that can be involved in social learning in prairie voles. New promising pharmacological agents are being tested to see whether it can impact social learning in voles.

The Subramanian lab is studying Parkinson's disease by exposing rats to Paraquat, so they have

a motor and cognitive decline associated with their pathology. Caroline Swain and Dipesh Pokharel are conducting research on these rats and subjecting them to different behavioral and motor tests to understand the pathophysiological development of Parkinson's disease and how these deficits can be reversed using Squalamine.

### **Neuroimaging and Physiology**

Neuroimaging research seeks to examine the brain mechanisms of a disorder or to help assess biotypes based on targeted brain circuitry.

The Wang and Xie lab is using fMRI to study Post Traumatic Stress Disorder (PTSD). Neuroimaging studies are being done to study the neural changes that occur after exposure to trauma and to study the neural correlates of PTSD pathology. Sharad Chandra, Derrick Asante, Safiya Dzotsi, and Charles Adams have used structural and functional MRI and machine learning to explore PTSD brain thickness and brain function after exposure to a traumatic event and the brain connectivity changes associated with living with this pathology.

The Pappada lab uses wearable technology to understand how people's physiology changes when under stress. Jacob Schmieder used wearable technology to identify stressful situations among opioid users and factors that lead to relapse. More recently, the lab focuses on using machine learning and artificial intelligence to provide clinical decision support and support providers in the optimization of patient safety and care.

The Andari lab is actively using psychometric, clinical, behavioral, and neuroimaging tools in combination with advanced machine learning approaches to generate biologically relevant subtypes of autism spectrum disorder (ASD). Gabby Vento used random forest analysis to categorize NT and ASD subjects using behavioral tools and to generate subtypes and then used

neuroimaging data to validate them. Gabby McMunn presented some work on how teachers' scores can enhance the accuracy scores of a model during prediction analysis of ASD diagnosis.

### Clinical Case Studies

Case studies are used to examine direct applications of medical knowledge and practice to specific patient cases.

Sarah Porter and Eric Lassiter worked with Dr. Adel Maklad to examine unusual anatomical variations within carveries and found that C1 and C5 nerve roots are associated with neurological issues. This gave further direct illustration of the internal anatomy associated with different pathologies.

Dr. Adam Koenig and Dr. Victoria Kelly wrote case studies on exceptional circumstances that occurred within the Psychiatric units. For instance, they discussed the use of buprenorphine to treat chronic pain with diabetes, memantine to treat catatonia, and neuropsychiatric features of hypothyroidism. These case studies illustrate how clinical experience is directly affecting patient care.

### Population Health and the opioid crisis and abuse

During the COVID-19 pandemic, there was an alarming increase in opioid overdoses which required more Naloxone to be distributed to better serve communities.

Dr. Tanvir Singh's team conducted a retrospective analysis of opioid overdose analyzing trends before, during, and after the pandemic. In addition to providing insights into the effects of the lockdown, this work advocated for more widespread distribution of Naloxone kits to combat the opioid crisis.

Dr. Blair Hermiller worked with Dr. Chelsea Myles

on studying elder abuse during the COVID-19 pandemic lockdown period in Ohio. There was an increase in elder abuse cases that occurred during the lockdown precautions which put elders at risk for abuse.

### Medical Training

UT is committed to educating all levels of students and professionals to optimize patient care.

The first program, being run by Dr. Garrett Spradley and Dr. Victoria Kelly, looks to optimize the new resident onboarding process and how to better mentor residents so that they reach their full potential and to optimize patient quality of care. Together, they conducted a meta-analysis of 22 papers analyzing different simulation technologies and training systems for on board residents. This information will be used for the onboarding process and to set up new students for success.

The second program, being created by Dr. Adam Koenig and Dr. Victoria Kelly, examines training physicians on how to manage HIV and mental health disorders together, which are two commonly co-occurring diagnoses. A new 20-minute training presentation was tested to educate providers on neuropsychiatric pathologies and HIV and the providers. Before and after the training, the providers were tested on their knowledge with these patients and to rank their confidence and interest in training patients with HIV and neuropsychiatric disorders. The training was shown to significantly increase the provider's knowledge in caring for patients with these co-occurring disorders and increase their confidence in doing so.

### Summary

These projects illustrate the Departments of Neurosciences and Psychiatry commitment towards empowering professionals and helping patients. Every project, experiment, grant

submitted, and paper published is but a step towards advancement behavioral health care and translational neuroscience. No matter what level of research we are conducting, no matter academic rank, or our job in the department – we are all working together today to strive for a better tomorrow. Let the confines of this research symposia proceedings be a testament of our collective efforts to advance the field of translational neuroscience so that everyone may live their life happily, healthily and to fullest.

**Copy Editors Note**

The innovative and impressive research being conducted at The University of Toledo shines light on both the dedication of the faculty members and scientists, but also the range of students involved. Reading through each of the lab's works left us amazed and incredibly proud to call the University of Toledo our academic home. This displays the dedication of each institutional member towards both the expansion of knowledge, but also the advancement and betterment of science and society.