



**LIBR**

Laureate Institute for Brain Research



**SCIENTIFIC  
REPORT**

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**2022**



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**LIBR** Laureate Institute for Brain Research

The Laureate Institute for Brain Research (LIBR) facilities consist of 27,000 square feet of space entirely dedicated to neuropsychiatric and neuroscience research on the campus of the Laureate Psychiatric Clinic and Hospital (LPCH) at Saint Francis Hospital in Tulsa, Oklahoma.

**42** Offices, including 3 large shared spaces for students and volunteers

**5** Conference rooms

**2** MRI bays and adjoining control rooms

**3** Psychophysiology testing rooms

**2** Behavioral observation rooms

**2** Medical/blood draw rooms

**1** Mock scanner room

**1** Neuropsychological testing room

**1** Transcranial magnetic stimulation (TMS) room

**3** Bioassay rooms

**2** Float rooms





# Letter from the President

MARTIN P. PAULUS, M.D., Scientific Director and President

LIBR, as a research institute that aims to develop neuroscience-based approaches to better prognose, diagnose or treat individuals with mental health problems, exists in a rapidly changing environment.

Over the past year, research in psychiatry has continued to grapple with several significant challenges. These include bridging the gap between neuroscience and clinical psychiatry, applying large scale genetic data, employing new phenomenological approaches, incorporating machine learning techniques, expanding preventative and digital psychiatry, addressing structural racism, and developing new pharmacological treatments.

The gap between neuroscience and clinical psychiatry persists, despite efforts to bridge the two disciplines. Although there are increasingly sophisticated tools available to probe cellular function of the brain, these tools cannot be used to examine the living brain. This limitation makes it difficult to translate the insights gained into how micro-circuits process fear and other important constructs into normal versus pathological functioning in anxiety disorders. Also, genetic studies have shown limited success in providing mechanistic insights into predicting mental illness.

Machine learning, broadly defined as the capability of a machine to imitate human behavior, is also playing a growing role in psychiatry. One application is the use of patient stratification, which involves dividing patients into subgroups based on their clinical characteristics

and responses to treatment. The goal is to achieve more personalized and effective treatments based on individual characteristics.

Preventive psychiatry, which focuses on preventing the onset of mental illness, is also gaining attention. For example, there is a growing need to develop preventative approaches to mitigate the impact of climate change on mental health, which can range from depression or anxiety to substance use and PTSD.

Digital psychiatry, involving the use of technology to deliver mental health care in a more convenient and efficient fashion, is also becoming increasingly important, especially in areas lacking access to treatment providers. As this field evolves, it will require new measures and frameworks to ensure its effectiveness.

In addition, the field of psychiatry is also grappling with issues related to the impact of structural racism on mental health. Structural racism refers to the systemic discrimination and bias that affects individuals from marginalized racial and ethnic groups, which can have a profound impact on mental health. By recognizing and addressing structural racism, practitioners can better serve all individuals, regardless of their race or ethnicity. Continued research is needed to optimize treatments that address the unique needs of these groups.

In terms of pharmacological treatments, there have been several recent developments. For example, new

medications for the treatment of depression, anxiety, and other mental illnesses have been developed and approved by regulatory agencies. In addition, there is growing interest in the use of psychedelics, such as psilocybin and MDMA, as potential treatments for mental health conditions.

Given this background, it is noteworthy that LIBR is tackling many of these issues as highlighted below:

**1 Neuromodulatory approaches:** Masaya Misaki, Maria Ironside, Salvador Guinjoan, and Aki Tsuchiyagaito are implementing various forms of neuromodulation to improve symptoms of individuals with mood and anxiety disorders. However, beyond the pragmatic approach of using tools such as transcranial direct current stimulation, low-intensity focused ultrasound, or real-time functional magnetic resonance imaging neurofeedback to target symptoms, our investigators want to understand the brain processes that are important for the effect so that in the future we can develop more targeted and effective interventions.

**2 Interoceptive dysfunctions:** Sahib Khalsa, Jennifer Stewart, Ryan Smith, and I continue to have a keen interest in how information coming from the body and the body state shapes brain processing and influences mood, anxiety, and substance use disorders. Over the past year, Ryan has developed a sophisticated computational approach to measure specific process dysfunctions that relate to interoceptive processing and its influence on motivated behavior. These findings are important because they provide the evidence base to use interventions such as floatation and other modulations of the body state to improve mental health.

**3 Culture, lifestyle, and environmental influences:** Evan White has been interested in the cultural determinants of resilience to mental health and substance use disorder. In particular, he is developing a program of research that examines how the cultural heritage of American Indian individuals contributes to mental health resilience. This area of research is still very new territory, and we are making important discoveries—e.g., how the brain processes stimuli (auditory or visual) that are highly associated with one's cultural background. Ultimately, these insights will help to develop culturally sensitive and efficacious interventions.

**4 Large-scale population data to obtain insight into the risk and prognostic factors:** It is becoming increasingly clear that robust predictive measures require large databases to assure that we have adequate representation of different groups of individuals with psychiatric disorders. Chun Chieh Fan and Wesley Thompson joined the LIBR team this year to focus

on bringing state-of-the-art population genetics and machine learning to identify robust biological markers for mental health conditions.

**5 Innate and adaptive immunity, inflammation:** Jonathan Savitz, Leandra Figueroa-Hall, and Haixia Zheng are working on immune, inflammation, and viral sources of mental health problems. They are examining these effects both on a systems neuroscience level, i.e., determining the effects of viral exposure on white matter tract pathology in depression, and on a molecular level, i.e., understanding how the Toll-Like Receptor 4 system is affected in individuals with mood disorders.



Laureate Institute for Brain Research Campus

**6 Brain-based mechanisms of behavioral and/or pharmacological interventions:** Robin Aupperle has made significant progress in delineating how different behavioral interventions affect the brain of individuals with anxiety and depression. It is becoming increasingly clear that the brain systems that affect our degree to which we approach or avoid activities are modulated by behavioral interventions such as behavioral activation therapy. Robin will be working on determining how we can better predict who might respond best to a particular intervention to reduce the trial-and-error of selecting treatments for individuals with mood and anxiety disorders.

Research is a marathon, not a sprint. It is important to keep our focus on our primary mission of reducing suffering among those individuals with mental health conditions. LIBR is making progress in an exciting and challenging field, and we are increasingly looking to translate our findings into actionable programs that will make an impact in the field. Finally, I would like to thank The William K. Warren Foundation for their continued, generous, and unwavering support for our research.





# LIBR Mission, Vision, and Values

## MISSION

Our mission is to develop knowledge, tools, techniques, and interventions that improve mental health. Using neuroscientific approaches, we generate scientific products for stakeholders that provide better ways of assessing, treating, and preventing mental health conditions.

## VISION

A clinical neuroscience research institute that recognizes the dignity and uniqueness of each person and leverages leading talent and technology to discover causes of and cures for disorders of mood, anxiety, eating, and substance use.

## VALUES OR GUIDING PRINCIPLES

Understanding each individual affected by a mental health condition requires deep empirical knowledge of psychiatry and related areas, detailed quantitative assessments, and contextual knowledge of the individual and the community in which they exist. This comprehensive approach is the basis for developing better assessments and treatments.

## SPECIFIC AIMS

1

To identify, characterize, and develop targetable, disease-modifying processes in mental health.

2

To develop neuroscience-based interventions to improve mental health.

3

To provide a core service infrastructure to accelerate discoveries by LIBR investigators.

4

To develop and maintain a workforce of scientific researchers focused on advancing the strategic goals of LIBR.

## HISTORY

LIBR opened on May 1, 2009, and currently houses a multidisciplinary team of scientists and clinical research staff who apply neuroimaging, genetic, pharmacological, and neuropsychological tools to investigate the biology of neuropsychiatric disorders. Founded by The William K. Warren Foundation, LIBR's purpose is to conduct studies aimed at developing more effective treatments and prevention strategies for these disorders. The studies are led by scientists from diverse backgrounds, including physics, cognitive neuroscience, psychology, psychiatry, developmental neuroscience, computer science, and genetics.





# 2022 LIBR BY THE NUMBERS

10

principal investigators

5

associate investigators

5

affiliate investigators

6

staff scientists

8

post-doctoral fellows

5

graduate students

80+

external collaborative investigators

24

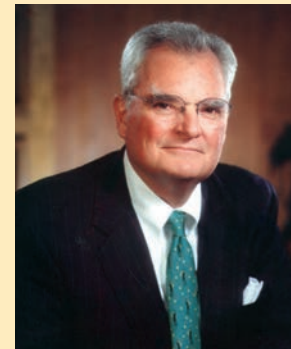
active grants and clinical trials

12

new externally funded grants

8.7

million in external funding



5

speakers for The William K. Warren Foundation lecture series

8

visiting scientists and distinguished guests

2

diversity in mental health speakers

3,440

inquiries for study participation

1,087

magnetic resonance imaging (MRI) scanning sessions

1,897

participants across all studies

281

participants enrolled in their first MRI study

108

peer-reviewed journal article publications by LIBR investigators





# LIBR Leadership



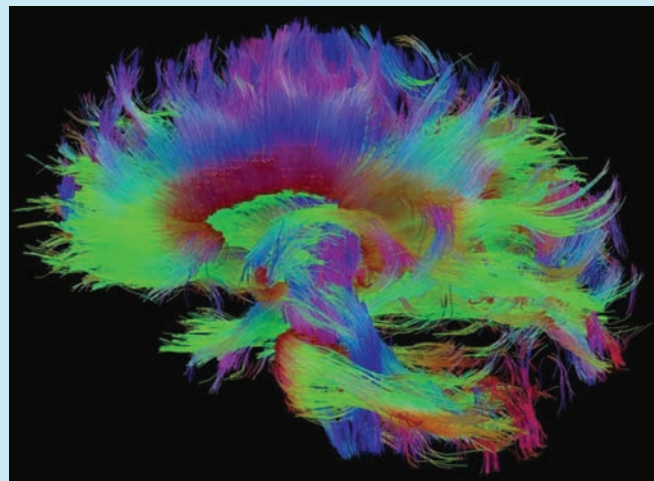
**Martin Paulus, M.D.**  
Scientific Director and President



**Colleen McCallum, M.B.A.**  
Chief Operating Officer



**Michael Rohan, Ph.D.**  
Chief Technology Officer



**The goal for LIBR** is to identify disease-modifying processes based on circuits, behavior, or other levels of analysis, which—when modulated—change (1) the risk for, (2) the severity of, or (3) the recurrence of a disease such as mood, anxiety, or substance use disorder.

# CURRENT AREAS OF EXCELLENCE





# ABCD Study

The Adolescent Brain Cognitive Development (ABCD) study is in its 7th year of research. LIBR is one of 21 sites across the country. The ABCD study is funded by a U01 grant from the National Institute on Drug Abuse (NIDA), with Drs. Paulus and Aupperle serving as PI and Co-PI for the LIBR site. This study originally recruited >11,000 youth ages 9-10 to join the study, which involves tracking of biological, behavioral, and emotional development through adulthood. LIBR is currently working to complete the 4th-year assessments, continue the 5th-year assessments, and has recently begun the 6th-year assessments with participants, who are now 15-17 years of age.



The study sponsors (NIH Institutes, including NIDA) have continued their dedication to open science, and in October 2021, the ABCD4.0 data set was released at NIMH Data Archive. The data release contains the complete data sets for the baseline, 6-month, 1-year, 18-month assessments and partial data for 2-year, 30-month, 3-year, and 42-month assessments. The ABCD consortium, along with scientists from all over the world have begun examining the data, available at ABCD Publications. The LIBR group has continued to contribute to this literature, including recent publications reporting the limits to the generalizability of resting-state functional magnetic resonance imaging studies of youth (led by Kelly Cosgrove, MA) and providing five recommendations for using large-scale publicly available data to advance health among American Indian peoples (led by Dr. Evan White). Additionally, 5 posters utilizing ABCD data were presented at the first annual LIBR Research Day by ABCD research assistants. These projects examined the relationships between prenatal cannabis exposure, reaction time, and working memory (led by Alexandria Cooper), mental health and religion (led by Victoria Resch), mental health in minority youth (led by Ciboney Ware), discrimination and family environment in Hispanic youth (led by Alicia Pacilio), and COVID-19 and mental health (led by Nicholas Tshahridis).

The ABCD team is continuing to change and grow. This year Trinity Lasswell and Maria Acosta were promoted to, and Sherille Bosfield was hired into, the positions of Research Specialists. They are in charge of Data Management, Training, and Logistics, respectively, to lead the ABCD team in place of a single study site coordinator. In 2022, the ABCD team also welcomed seven new research assistants: Berenice Acosta, Alexandria Cooper, Sheridan Ray Foxworth, Melanie Curry, Alicia Pacilio, Victoria Resch, and Ciboney Ware and promoted two former interns into research assistant positions: Ailis Reavey and Jolene Tay. Additionally, Melanie Curry was promoted from research assistant to Participant Engagement and Support Coordinator for the RECOVER sub-study to examine the impact of long-term effects of the COVID.

The LIBR/ABCD team is looking forward to a new data release in the early months of 2023 and will continue to contribute to this important ongoing longitudinal research in the years ahead.



**The ABCD team hosted a Family Appreciation Event in October. They invited over 740 participants' families to visit the Saint Francis Hospital campus. This was the first time to host the typically annual event since the beginning of the COVID-19 pandemic. The goal of the Family Appreciation Event is to provide study updates, answer participants and caregivers' questions about the study, share recent study findings, and provide an opportunity to connect with our youth and family in a relaxed environment while sharing a meal together. Parents were engaged in an active discussion at the end of the evening, focusing on topics ranging from the impact of screen or social media on mental health to concerns about the impact of cannabis and other drugs on brain development. This year, the ABCD team, led by Sherille Bosfield (Research Specialist in charge of Logistics), planned a Fall theme, which included pumpkin painting and carnival games to earn raffle tickets and prizes. This year's event was a huge success, and over 220 people attended!**

# Tulsa 1000



The Tulsa 1000 (T-1000) study, the largest study at LIBR, began in January 2015 and completed baseline enrollment of all 1,000 participants in 2018. Participants with disorders of mood and anxiety, eating and substance use completed over 24 hours of baseline testing, including clinical interviews and behavioral and neuroimaging assessments of emotion, cognition, reward, and interoception. Longitudinal assessments were conducted with one-hour follow-up interviews at 3, 6, and 9 months and an 8-hour follow-up session at the one-year completion mark. Yearly follow-up assessments continued throughout 2022. The goal for this study is to determine whether neuroscience-based measures can be used to predict outcomes in patients with mental illness. In particular, we are trying to determine what factors best predict who will respond well to a particular treatment. The study is a definitive step toward developing a science-based personalized medicine approach in mental health.

To date, over 30 papers have been published by the T-1000 project authors and their collaborators. Data analysis of the T-1000 variables is ongoing, with over 50 individual scientific papers in progress for publication. Publications thus far have covered the topics of the relationship between gray matter volume and childhood trauma; behavioral and neural responses during fear conditioning and extinction, the impact of serotonergic medication on interoception; neural processing dysfunctions in depressed individuals with high levels of repetitive negative thinking; the development of automatic pipelines for pre-processing EEG-fMRI data; EEG microstates as an electrophysiological signature

of BOLD resting state networks and characterization of abnormalities in mood and affective disorders; the prediction of brain age from EEG signals using a machine learning approach and the relationship to chronological age; the effect of neighborhood factors on brain structure and function, how body characteristics predict motion in the scanner; how early life stress and adult cytomegalovirus infection are related in mood and anxiety disorders; how processing of body signals differs in individuals with opioid and stimulant use disorders; a potential fMRI based biomarker for substance use disorder, interoceptive responses in suicide attempters; reward activation with cannabis use in anxious and depressed individuals; elevated peripheral inflammation and reward anticipation in major depressive disorder; polygenic risk scores for neuroticism, rumination circuits within the brain using real-time fMRI functional connectivity neurofeedback; latent variables for brain activation during the monetary incentive delay task; sex differences in inflammatory mediators as a function of substance use disorder; and the distinct oral microbiome pattern in individuals with substance use disorders.

The "Tulsa 1000 Investigators" typically include the following contributors: Robin Aupperle, Ph.D., Sahib S. Khalsa, M.D., Ph.D., Rayus Kuplicki, Ph.D., Martin P. Paulus, M.D., Jonathan Savitz, Ph.D., Jennifer Stewart, Ph.D., and Teresa A. Victor, Ph.D. For laboratory contributions to analyses of blood/microbiome/saliva, additional contributors include: Kai Ping Burrows, Ph.D. and Leandra Figuerosa-Hall, Ph.D.

**In addition to publications, biweekly discussions of data analysis pathways and scientific findings with the principal investigators, associate investigators, staff scientists, and post-doctoral fellows offer opportunities for new ideas to explore as we work toward developing a personalized treatment approach through the knowledge gained with this comprehensive dataset.**





## “Racism and Science: A Call for Action”

**Martin Paulus, M.D.**  
Scientific Director and President

The position statement “Racism and Science: A Call for Action” was written by Dr. Paulus in 2020, after the murder of George Floyd. Given the events of the last 2 years, it continues to hold true in 2022. There are three key elements:

- 1** to enhance our assessment and understanding of context and environment (e.g., social determinants of health) in relation to mental health problems and neuroscientific findings;
- 2** to make an effort to diversify our workforce so that we can bring as many perspectives to our research as possible;
- 3** to work with community stakeholders to arrive at better research questions that can solve problems that affect minoritized communities.

This work is a process, and there is not a finish line to aim for. Through this work, we as individuals and we as an institute have and continue to learn how racism has contributed to science and the systems that support science, our role in these racist systems, and how our actions can either contribute to the ongoing racism or help move us toward healing. Dr. Robin Aupperle, Chair of the Diversity and Inclusion Workgroup, communicated how inspiring it has been to observe and be part of an accelerated appreciation in the fields of neuroscience and mental health for how people’s individual, lived experiences within the world impact behavioral and neural responses, mental health symptoms, and the factors that incur resilience.

In 2022, our quarterly seminar series dedicated to Diversity in Neuroscience brought to Tulsa two talented investigators working at the intersection of diversity and neuroscience. Dr. Nathaniel Harnett from McLean and Harvard Medical School discussed his work focused on understanding the brain basis for why some people are more likely to develop stress-related disorders, including the impact of racial discrimination and how experiences of racial discrimination impact findings in the fields of neuroimaging and PTSD. Dr. Neha John-Henderson from the University of Montana discussed her work focused on biopsychosocial and behavioral pathways connecting historical loss to mental health in the Blackfeet tribal community. In addition, a monthly reading and discussion group has been ongoing, where all faculty and staff at LIBR are invited to join a discussion of readings related to topics such as racial disparities in mental health, the concept of neurodiversity and issues of ableism in academia, misconceptions of brain and biological sex and gender, the psychosocial impact of hate crimes on Asian American and Pacific Islander communities, and strategies for incorporating measures of social determinants into neuroscientific analyses. As part of these discussion groups, we have had the opportunity to discuss journal articles by LIBR faculty focused on (1) recommendations for using large-scale publicly available data to advance health among American Indian peoples (lead author: Evan White, Ph.D.) and (2) the role of racial discrimination in dissociation and interoceptive dysfunction (senior author: Sahib Khalsa, M.D., Ph.D.).

The Diversity and Inclusion Workgroup also supported the continuation of the Diversity in Research and Multidisciplinary Neuroscience (DReaM-Neuro) Fellowship and the LIBR Advanced Summer Research (LASR) internship, both of which have been successful in not only supporting undergraduate and post-baccalaureate students in their educational and professional goals but also in recruiting new talent to LIBR. Over the past year, we also organized a series of staff-wide trainings from the Oklahoma Center for Community and Justice on Civil Conversations and Communications Best Practices, with the aim of supporting our ability to engage in effective communications in the workplace, particularly around difficult topics.

In the larger, U.S. neuroscience community, Dr. Evan White and Dr. Robin Aupperle joined the Culture and

Environment workgroup for the multi-site Adolescent Brain and Cognitive Development (ABCD) study, for which LIBR is also a site. Dr. White is also serving as the chair of the Native American Issue in Behavior Therapy and Research Special Interest Group of the Association for Behavioral and Cognitive Therapies. Through the LIBR Diversity Initiative, we have also increased our presence in the local Tulsa community, attending events such as the American Foundation for Suicide Prevention Out of Darkness Walk, Tulsa Pride, and multiple Pow Wows in the region. We hosted the Tulsa Young Professionals Diversity group at LIBR for a panel discussion on diversity in mental health, featuring members of diverse backgrounds from LIBR and other professionals in the Tulsa area. We have also participated in numerous volunteer activities, including continuing a pen pal program with middle schoolers in a local gifted program and volunteering at The Bridges Foundation for individuals with special needs as part of the Tulsa Day of Caring and with La Cosecha/The Harvest helping to distribute school supplies. We also organized donation drives for school supplies and for Christmas gifts for children of women in the Women in Recovery (WIR) program. This spring, we began releasing a monthly newsletter sent to all staff at LIBR summarizing diversity-related events within the institute and in the community, as well as providing education about historical neuroscientists from underrepresented backgrounds and their contributions to the field.



The LIBR Diversity and Inclusion workgroup is proud of the accomplishments since being established in 2020 but also has numerous goals for this coming year and

into the future. We look forward to establishing new community partnerships, further increasing the representation of under-represented groups in science, and further enhancing our research through the consideration of modifiable factors that may increase risk or protect against mental health problems for individuals of diverse races, ethnicities, cultures, and backgrounds.





## LIBR EEG Core Facility

The Electroencephalography (EEG) Core is among the newest addition to LIBR's core services, established in January 2022 and previously operated under LIBR MRI and EEG Neuroimaging facility since June 2010. The EEG Core provides LIBR researchers and external collaborators with easy access to state-of-art equipment, tools, resources, technical support, and preprocessing needed for research including EEG techniques. Our goal is to implement best practices of EEG acquisition, data processing, and analysis in order to enable investigators to conduct world-class EEG research.

The EEG Core is equipped with two complete sets of up to 128-channel high density MRI compatible BrainAmp-MR-plus EEG systems for measuring brainwaves within MRI scanners. Also, the Core supports standalone 32-channel BrainAmp EEG system for recording standard EEG brainwaves outside MRI scanners for more traditional EEG protocols. Each recording system can be paired systems for recording physiological signals simultaneously. The functionality of main hardware, accessory equipment, and consumables are maintained and inspected regularly by EEG Core staff to ensure the quality of each scanning session. Recorded raw neurophysiological data are digitized online and stored on the LIBR server.

The EEG core supports preprocessing through standard and customizable pipelines using BrainVision Analyzer software or Matlab based EEG/ERPlab. Most processing is done by trained EEG Core staff to ensure processed data meets the standard of specific field and researcher needs. Our staff also provide services such as on-board training for research assistants and staff on EEG data acquisition (capping, recording, etc.) and basic processing, consultation for study design, data collection, analyses strategies, assisting with institutional review board applications, pipeline customization, programming, grant methods, and result interpretation upon request. Since the facility was established, we have hosted a hybrid EEG training workshop, several in-person data acquisition training courses, and research consultation sessions.

**The EEG Core is directed by Dr. Evan White, LIBR Principal Investigator, an expert in EEG/event-related potentials (ERPs) and clinical translation psychophysiology, supported by staff scientist Dr. Xi Ren, specialized in EEG/ERP analysis and source localization, and research assistant Eric Mann, B.A.**



## LIBR MRI Neuroimaging Facility

Established in July 2009 and in research operation since June 2010, the MRI facility provides advanced state-of-the-art MRI, functional MRI (fMRI), simultaneous electroencephalography (EEG) recording with fMRI, and real-time neuroimaging capabilities. Two MRI scanners are fully dedicated to research and provide an advanced capacity for the latest quantitative imaging of the human brain structure and online monitoring of brain activity in real-time. The two scanners can also be synchronized and integrated for hyperscanning, where EEG and fMRI signals of interacting two subjects are measured simultaneously.

In 2023 LIBR is planning the purchase of a new MRI system to replace the original system installed in 2009. The arrival of this new system with state-of-the-art coils and methods will support more powerful imaging results for LIBR research in the coming decade.

The facility provides all the latest technology, tools, and resources necessary to conduct and support brain neuroimaging studies focused on advancing clinical research to discover causes of and cures and novel interventions for mood, anxiety, eating, and memory disorders.

LIBR's custom-made data management system allows for automatic handling of large amounts of neuroimaging data and real-time integration of fMRI, physiological data (respiration, pulse oximetry, or electrocardiogram (ECG) waveforms), and EEG data simultaneously acquired with fMRI. These capabilities enable live monitoring of ongoing brain activation in real-time with extensive multimodal information. The application of real-time neuroimaging in LIBR

is expanding from an online data quality check to a neurofeedback treatment for psychiatric disorders, in which a patient is trained to self-modulate a dysfunctional brain activation with feedback of own brain state, and online optimization of brain stimulation with simultaneous transcranial direct or alternating current stimulation (tDCS/tACS) during fMRI.

The advanced combination and customization of state-of-the-art MRI, radiofrequency (RF) coils, EEG, and brain stimulation technologies, along with custom-developed software solutions and a wide range of auxiliary computerized equipment, offer a unique potential for conducting advanced brain research. The LIBR MRI facility also supports collaborative neuroimaging research with researchers from local academic institutes, including The University of Oklahoma, Oklahoma State University, University of Arkansas, and The University of Tulsa.

The MRI facility is directed by Michael Rohan, Ph.D., an expert in functional imaging systems and methods. It operates with the technical support of Masaya Misaki, Ph.D., an expert in multimodal neuroimaging data analysis and information technology and under the management of Julie Arterbury, Chief of MRI technologist. Other staff includes two MRI technologists, Leslie Walker and Amy Ginn. In 2022 the EEG technologies and data collection and processing transitioned to its own facility under Dr. Evan White.

**The MRI facility was created from the bottom up by Jerzy Bodurka, Ph.D., and is named in his honor.**





# LIBR Biomedical Laboratory Facilities



The LIBR Molecular Biology Facility houses four laboratory rooms dedicated to human blood processing, specimen long-term biobanking, bioassays, and extracellular vesicles (EV) research. Human blood and saliva are routinely collected, and blood is processed for serum, plasma, and peripheral blood mononuclear cells (PBMCs), aliquoted, and appropriately bio-banked for LIBR investigators.

The specimen sample processing room contains recently purchased state-of-the-art equipment including 1) a Biosafety Level 2 (BSL-2) laminar flow cabinet for making sterile aliquots of samples; 2) Beckman Coulter Avanti J-15R refrigerated centrifuge for blood cell processing; 3) small clinical centrifuges for serum and plasma processing; 4) Invitrogen Countess 3 Automated Cell Counter for cell counting; and 5) a label maker for labeling storage vials.

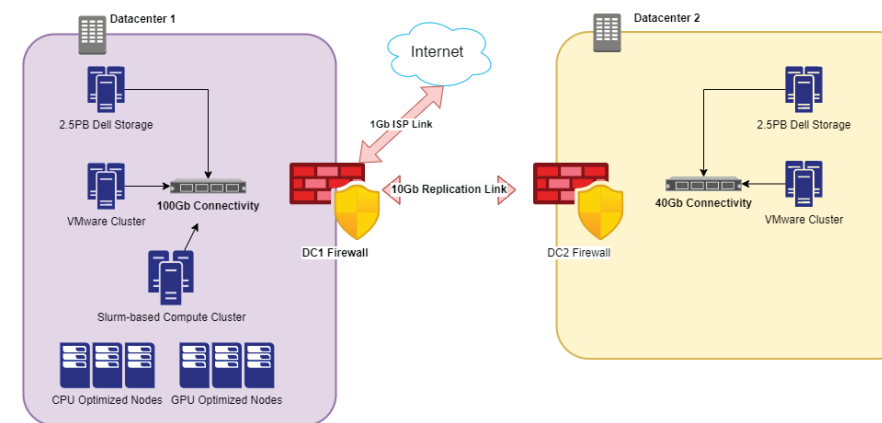
The biobanking room contains recently purchased, large, ultralow (-80°C) temperature freezers for specimen biobank and long-term storage. The biobanks are in secure rooms with access given only to approved personnel. All freezers used for biobanking are on continuous generator backup power. The freezers are monitored 24 hours per day with Sensaphone technology and Monnit Smart Monitoring Systems that send emails, text messages, and phone calls to laboratory director Dr. Kaiping Burrows and research specialist Valerio Coussa in case of any disruption in power, sensor disconnection, or change in temperature. The biobanks are monitored and tracked by biorepository monitoring and inventory software (Freezerworks) and kept on the LIBR server. In addition to electronic inventories, handwritten logbooks are securely stored in the laboratory in case of server loss of function.

The bioassay room is used to measure blood or saliva-based biomarkers using enzyme-linked immunosorbent assay (ELISA) to assess immune, metabolic, and stress related markers (e.g., IL-1ra, IL-6, leptin, adiponectin, HSP70, cortisol, etc.). The equipment/software in this room includes BioTek 50 TS automated microplate washer, BioTek 800 TS Absorbance Microplate Reader

with onboard software through color touchscreen interface, Gen5 software for advanced reader control and powerful data analysis, and flexible exporting/reporting tools. The automated microplate washer instrument is important for ensuring rapid and even washing of plates, which reduces intra- and inter-assay variability. The Gen5 software is designed for ELISA data and generates standard curves and statistics, which are then downloaded in standardized electronic reports for the investigators. Other equipment in the bioassay room includes a refrigerator, a freezer (-20°C), and an ultralow temperature freezer (-80°C) for storing ELISA kits or reagents that require 2°C to 10°C, < -20°C or < -70°C controlled temperatures; centrifuges to centrifuge plasma, serum, or saliva samples after defrosting; and single and multi-channel pipettors for bioassay precision and accuracy.

The EV research room is designed to isolate and characterize brain-enriched EVs from human serum or plasma. EVs carry molecular signals and are involved in intercellular central nervous system (CNS) communication by microRNA transmission. EV can cross the blood-brain barrier from both directions. As EVs attach to recipient cells and release microRNAs that potentially modulate the function of the recipient cell, they show potential as a therapeutic drug delivery platform. LIBR EV research will support investigators to study information from the brain using a non-invasive tool. Major equipment in this room includes 1) a NanoDrop for micro-volume analysis of purified nucleic acids; 2) a nanoparticle size analyzer to measure EV size and concentrations; 3) a large laboratory refrigerator for storing reagents and performing experiments (e.g., rotating samples overnight at 4°C) that require 2°C to 10°C controlled temperatures. Other equipment in the EV research room includes a sonicator for resuspending pellets, centrifuges for EV isolation and microRNA purification, a rotating mixer for gentle to vigorous mixing of laboratory samples, and an ice maker to create ice flakes for defrosting frozen plasma/serum samples and keeping some reagents cold during lab experiments.

# Data Management and Statistics Core



ANALYTICS HARDWARE	
8 SERVERS	2.2 TB OF RAM
2.5 PB OF STORAGE	
16X INTEL 6126 CPUS	4X NVIDIA P100 GPUS
2022 IN REVIEW	
10,481 DAYS OF CPU TIME	303,928 ANALYSIS JOBS
22 STUDIES IN BIDS FORMAT	

The DMS Core makes research at LIBR possible by providing services from data collection and organization through production of final results.

**Hardware:** LIBR maintains a powerful, remotely accessible analysis cluster running the SLURM batch scheduler. This allows researchers to run hundreds of jobs spread across an array of servers in a fraction of the time it would take on a local workstation. For a bit of perspective, the 8 analysis servers give researchers access to about as much computing power as 50 typical workstations. LIBR also has a newly upgraded, massive network attached storage system complete with **off-site backup in Oklahoma City**. This system provides superior performance and security on-site plus a recovery plan should there be a disaster at the LIBR campus.

**Data Analysis and Statistics:** The DMS Core provides consultation and support to every lab at the institute and is responsible for processing several shared datasets including the Tulsa 1000 and CoBRE Core. Services in this area include study design and project planning through developing custom analysis pipelines and interpretation of results.

**Data Management:** All studies conducted at LIBR are organized according to the **Brain Imaging Data Structure (BIDS)**. BIDS is a standard providing best practices for the organization and documentation of complex neuroimaging and related datasets. BIDS has become the de facto standard used across institutes, and data sharing arrangements are increasingly contingent on the format. The DMS Core also facilitates compliance of funded studies with the new NIH data sharing policy.





## The LIBR Float Clinic & Research Center (FCRC)

The Laureate Institute for Brain Research is home to the world's first research laboratory investigating the effects of floatation therapy on both the body and the brain, as well as exploring its potential as a therapeutic treatment for improving mental health and well-being in individuals with various forms of psychiatric disorders including anxiety, depression, or eating disorders.

The FCRC is directed by Dr. Sahib Khalsa and is currently in its sixth year of operation. Initial studies published in 2018 found that floating appears to quickly reduce levels of stress, muscle tension, and blood pressure in individuals with anxiety and depression. A study published in 2020 led by Dr. Khalsa found floating to be safe in outpatient individuals with eating disorders and lowered levels of anxiety, stress, and blood pressure, as well as improved body image. A study published in 2021 found patterns of reduced functional connectivity between regions of the brain involved in mapping body sensation and self-representation in healthy individuals after floating. This study provided the first functional neuroimaging evidence of the effects of floating on brain function. Another study published in 2022 found changes in heart rate variability and blood pressure during floating, providing further evidence that it lowers sympathetic arousal and alters the balance of autonomic nervous system functioning toward a parasympathetic state.

Building from this base of knowledge, ongoing clinical trials are examining the potential therapeutic impact of floatation therapy on several psychiatric conditions. In 2022 Dr. Khalsa completed data

collection for the first NIH-funded clinical trial investigating the feasibility and tolerability of floatation therapy as a technique for reducing anxiety and depression in individuals with high levels of anxiety and depression. A second LIBR-funded clinical trial led by Dr. Khalsa investigates the efficacy of floatation therapy as a technique for reducing body image disturbance and anxiety in individuals with anorexia nervosa hospitalized for inpatient treatment at the Laureate Eating Disorders Program. This study is conducted in partnership with Dr. Scott Moseman, the medical director of the Laureate Eating Disorders Program and the clinical staff from the program. The primary manuscripts for both studies were submitted for publication, so stay tuned for further updates in 2023.

**In 2022 Dr. Khalsa launched a third LIBR-funded clinical trial examining the safety and acute effects of floatation therapy in individuals receiving inpatient treatment for amphetamine use disorder, in collaboration with Dr. Jennifer Stewart, LIBR's Director of Training and Mentoring. The results of the pilot study demonstrated the safety of the intervention in this population and some early signs of positive clinical impact, which will form the basis for future NIH grant submissions. Overall, 2022 was a fruitful year for the FCRC, with studies from the center showing evidence of safety, feasibility, or clinical impact for three major types of psychiatric conditions.**



## Focused Ultrasound

Over the course of 2022, LIBR has set up a *transcranial low-intensity focused ultrasound (LIFU) device*, a novel method for modulating the activity of brain circuits in a safe, noninvasive, and reversible manner. Whereas the ability of high-frequency soundwaves to change the activity of neural tissue was first detected nearly a century ago, the potential of this technique to produce neuromodulation in humans that could serve research and, eventually, therapeutic purposes, was not fully recognized until very recently. LIFU can produce changes in the neuronal activity and signal traffic in discrete areas of the brain. This could establish the role of a brain circuit in a complex behavior or in a mental health symptom. This capability aligns optimally with LIBR's aims and objectives in its quest to understand the neurobiological bases of psychiatric conditions and potential treatments for them.

In LIFU, a transducer converts electrical into mechanical energy in the form of high frequency soundwaves (250-500 kHz), able to traverse the skin and the cranium and focus on a certain region of the brain. Since the device used at LIBR permits steering the depth of the ultrasound focus, the resulting mechanical energy can be concentrated in a relatively small region with anatomical precision. This is done with the help of a neuronavigator, a complex optical system and software that guides the operator by computing the position of the transducer and the location of the tissue to be modulated, in a similar way to a GPS. This arrangement is being explored as a promising technique that would allow researchers to target regions of the brain of similar size to those engaged by deep intracranial electrodes or even tissue ablation but in a safe, reversible, noninvasive, and cost-effective manner. Although this is an emerging method

and the field is still pursuing a standardization of stimuli, these characteristics make LIFU a human neuroscience research tool, which potential is unmatched by any other available technique.

LIBR has just started to use LIFU in a pilot and feasibility protocol that targets cortico-subcortical anatomical connections presumably involved in the generation of Repetitive Negative Thinking (RNT), a symptom affecting a variety of psychiatric disorders but particularly prominent among persons with Major Depressive Disorder and a variety of anxiety disorders. In these groups, RNT worsens prognosis by producing protracted and residual symptoms, resistance to first-line treatments, and even suicide. Thus, it is of great interest to understand and modulate the brain circuits that produce RNT, and LIFU holds promise to accomplish both things. First, it can help to define a causal relationship between neural signal traffic in a circumscribed brain circuit and the production of RNT. Second, it can pave the way to treat this important symptom, be it directly or by defining the appropriate target for other, longer lasting neuromodulatory procedures. This LIBR pilot protocol has recently received a non-significant risk assessment by the U.S. Food and Drug Administration (FDA) and, after receiving regulatory approval, is starting to recruit participants. The multidisciplinary team of this study includes Megan Cole, Lindsay Bailey, Dara Critten, and Courtney Boone in the assessment of participants, whereas the operation of the experiments is done jointly by Aki Tsuchiyagaito and Salvador Guinjoan.



Center for Population Neuroscience  
and Genetics Center Directors:

Chun Chieh Fan and Wesley Thompson



# PNG Center Vision

As neuroscientific studies mature to sample sizes and diversity relevant for making population inferences, the field is just beginning to realize the need for integrating multiple existing research frameworks, including epidemiology, data science, genetics and genomics, and biophysics into a consistent framework. From national health registries, to large-scale imaging cohorts, to single cell molecular assays, there is a pressing need (with corresponding funding calls from agencies) to combine multi-scale/multilevel data to understand the neurobiological basis of human behavior and mental health and to ascertain the factors impacting neuropsychiatric outcomes in diverse populations.

The PNG Center aims to fulfill this need by developing and applying cutting-edge analytic methods from multiple fields (e.g., causal inference, psychometrics, high-dimensional Bayesian inference) to address these challenges under the rubric of Population Neuroscience. A multidisciplinary PNG investigative team is extending an epidemiologically- and psychometrically-informed causal inference framework to neuroscientific research (existing in vivo human datasets from population registers and large-scale imaging genetic studies), developing and applying novel statistical and bioinformatic tools to critically examine the potential biases, causal pathways, and heterogeneity in longitudinal, lifespan neuropsychiatric outcomes.

With core PNG faculty and staff dedicated to curating and accessing existing large-scale datasets, building necessary bioinformatic pipelines, managing the data inflow/outflow, exploratory data analyses

and developing novel data science tools, we are forging a path toward better understanding of the factors shaping human brain development, how pathological symptoms emerge, heterogeneity in prognoses, and population-level impacts of exposures and outcomes.

As a commitment to understand the diversity of the human brain, the PNG Center is dedicated to recruiting and maintaining highly diverse staff and collaborators. By integrating perspectives from researchers with diverse backgrounds, we will foster an environment ideally situated to focus on important public health problems, revealing causal factors underlying the heterogeneous effects and outcomes commonly-observed in population neuroscience data.

Using the PNG Center as a hub for fellow researchers from multiple fields (e.g., neuroscience, genetics, epidemiology, data science, statistics, psychology, and psychiatry), we can move the field toward better analytic practice, more accessible research tools, and deeper understanding of heterogeneity of neuropsychiatric outcomes at the population level. With insight gained from vertical integration of whole-brain imaging analyses, population cohorts, and detailed molecular assays, we will be closer to discovering leverage points for improving psychiatric well-being.

### Dr. Sahib Khalsa's Lab



**Dr. Charles Verdonk** received several scholarships including from La Fondation des Gueules Cassées, the Fédération pour la Recherche sur le Cerveau (FRC), the Union Nationale de Familles et Amis de Personnes Malades et Handicapées Psychiques (UNAFAM) and the Phillippe Foundation, Inc., to support exchange programs at the postdoctoral level between France and the United States.



**Emily Adamic** received a Chapman Graduate Student Travel Award from The University of Tulsa to present a research project at the Human Brain Mapping meeting.



**McKenna Garland** received a Graduate Student Association Travel Award to present a research project at the Anxiety and Depression Association of America conference entitled: Acute and additive effects of repeated REST (Reduced Environmental Stimulation Therapy) on symptoms in a clinically anxious and depressed sample.

### Dr. Robin Aupperle's Lab



**Kelly Cosgrove** successfully defended her dissertation entitled: The role of social and neural connectedness in predicting neurodevelopmental functioning in youth. She received an Internship Travel Scholarship from the National Register of Health Service Psychologists/American Psychological Foundation (APF).



**Timothy McDermott** successfully defended his dissertation entitled: Neurocognitive investigation of the effects of trauma exposure and sleep disturbance on emotional cognitive control. He received a Career Development Leadership Program Award from the Anxiety and Depression Association of America (ADAA).



**Jaya Chakka** obtained the Judge's Choice Award at LIBR's Research Day in November 2022



**Robin Aupperle** became a standing member of the National Institute of Health (NIH) Adult Psychopathology and Aging (APDA) Study Section.

### Dr. Leandra Figueroa-Hall's Lab



**Dr. Leandra Figueroa-Hall** received a K99/R00 grant entitled: "In vivo inflammatory challenge to elucidate the role of the toll-like receptor 4 pathway in depression".

### Dr. Jonathan Savitz Lab



**Dr. Jonathan Savitz** was elected as a member of the American College of Neuropsychopharmacology (ACNP) and was appointed as a standing member of the Neural Basis of Psychopathology, Addictions, and Sleep (NPAS) study section of the NIH. He is also listed among the world's most influential scientists for 2022 by Scopus (aka "Stanford University Rankings").

### Dr. Chun Chieh Fan's Lab



**Robert Loughnan** was selected as a semifinalist for the Epstein award at 2022 American Society of Human Genetics and orally presented his work on the plenary panel.

### Dr. Jennifer Stewart's Lab



**Megan Posey** was awarded a paid 2022 summer internship at LIBR from the National Institute of Drug Abuse (NIDA) to work on Dr. Stewart's NIDA-funded R01 grant entitled "Plasticity of Aversive Salience in Opioid Use Disorder."

### Dr. Aki Tsuchiyagaito's Lab



**Gabe Cochran** received a student travel award at Native Children's Research Exchange Network & Conference in September 2022. She presented on her work using machine learning with data from the ABCD Study to evaluate predictors for sleep disturbances, sleep length, and sleep delay in children.

### Dr. Martin Paulus' Lab



**Dr. Bohan Xu** successfully defended his dissertation "Associations between C-Reactive Protein with Physical and Mental Health Status Using Machine Learning" at The University of Tulsa.



## ACTIVE GRANTS

### National Institutes of Health (NIH): National Institute of Drug Abuse (NIDA)

*15/21 Adolescent Brain Cognitive Development (ABCD)-USA Consortium: Research Project Site at LIBR*  
04/15/2020 – 03/31/2027  
Principal Investigators: Martin Paulus, M.D. and Robin Aupperle, Ph.D.

*Plasticity of Aversive Salience in Opioid Use Disorder*  
03/01/2021 – 12/31/2025  
Principal Investigator: Jennifer Stewart, Ph.D.

### National Institute of Mental Health (NIMH)

*Neural Response to Inflammatory Challenge in Major Depressive Disorder*  
05/14/2021 – 4/20/2026  
Principal Investigator: Jonathan Savitz, Ph.D.

*A Neurocomputational Assay of Gastrointestinal Interoception in Anorexia Nervosa*  
09/01/2021 – 06/20/2027  
Principal Investigator: Sahib Khalsa, M.D., Ph.D.  
(co-funded by the National Institute for General Medical Science (NIGMS))

*An Approach-Avoidance, Computational Framework for Predicting Behavioral Therapy Outcome in Anxiety and Depression*  
07/01/2020 – 06/30/2025  
Principal Investigator: Robin Aupperle, Ph.D.

*Neural Basis of Meal Related Interoceptive Dysfunction in Anorexia Nervosa*  
05/01/2017 – 03/31/2023  
Principal Investigator: Sahib Khalsa, M.D., Ph.D.

*In vivo inflammatory challenge to elucidate the role of the toll-like receptor 4 pathway in depression*  
04/01/2022 – 03/31/2024  
Principal Investigator: Leandra Figueroa-Hall, Ph.D.

*Effects of pandemic-related disruption to social connectedness on the brain and emotional wellbeing in adolescents*  
06/01/2022 – 12/30/2026  
Principal Investigators: Chun Chieh Fan, M.D., Ph.D. and Wesley Thompson, Ph.D.

*Identifying and quantifying genetic effects on neurodevelopmental trajectories in adolescents*  
06/01/2022 – 01/31/2025  
Principal Investigator: Chun Chieh Fan, M.D., Ph.D.

### National Institute of General Medical Sciences (NIGMS)

*The Center for Neuroscience-based Mental Health Assessment and Prediction (NeuroMAP)*  
09/15/2017 – 06/30/2023  
Principal Investigator: Martin Paulus, M.D.

### National Center for Complementary & Integrative Health (NCCIH)

*Investigating Floatation-REST as a Novel Technique for Reducing Anxiety and Depression*  
09/25/2018 – 07/31/2022  
Principal Investigator: Sahib Khalsa, M.D., Ph.D.

### National Institute on Minority Health and Health Disparities (NIMHD)

*Neuroscientific Exploration of Cultural Protective Factors in American Indians*  
12/01/2022 – 11/30/2025  
Principal Investigator: Evan White, Ph.D.

### Brain and Behavior Research Foundation (formerly NARSAD)

*Examining the Utility of Frontoparietal Synchronization to Modulate Drug Craving to Enhance Self-Control to Cue Induced Cravings in Individuals with Opioid Use Disorder*  
01/15/2019 – 01/14/2023  
Principal Investigator: Hamed Ekhtiari, M.D., Ph.D.

### Oklahoma Center for the Advancement of Science and Technology (OCAST)

*Neurocognitive Empowerment for Addiction Treatment (NEAT): A Randomized Controlled Trial for Opioid Addiction*  
07/01/2018 – 03/31/2022  
Principal Investigator: Robin Aupperle, Ph.D.

### Presbyterian Health Foundation (PHF)

*Structural and Functional Markers of Injury in Cervical Spinal Compression*  
07/01/2020 – 06/30/2023  
Principal Investigators: Martin Paulus, M.D. and Zachary Smith, Ph.D.  
(University of Oklahoma)

### Wellbeing for Planet Earth Foundation, Japan

*Using active inference to uncover the neurocomputational mechanisms that contribute to well-being and their potential differences across diverse populations*  
04/09/2022 – 04/08/2025  
Principal Investigator: Ryan Smith, Ph.D.

## ACTIVE SUBAWARDS

### NIH: National Institute of Neurological Disorders and Stroke (NINDS)

*The role of neuroactive kynurenine metabolites in the chronic sequelae of concussion and contact sport exposure*  
12/01/2021 – 11/30/2022  
Prime Awardee: Medical College of Wisconsin – Timothy Meier, Ph.D.  
LIBR Subaward PI: Jonathan Savitz, Ph.D.

### NIH: NIMH

*Road Map to Precision Psychiatry: Comprehensive Investigation of Chromosomal Anomalies (PsychMap)*  
04/01/2021 – 02/28/2026  
Prime Awardee: Region Hovedstaden, Denmark – Thomas Werge, Ph.D.  
LIBR Subaward PI: Wesley Thompson, Ph.D.

*Estimating the Fraction of Variance Explained by Genetics and Neuroanatomy in Neuropsychiatric Conditions*  
08/15/2022 – 06/30/2027  
Prime Awardee: University of California San Diego – Armin Schwartzman, Ph.D.  
Multi-PI: Wesley Thompson, Ph.D.

*Population-Level and Mechanistic Dissection of 17q21 Structural Variant Association with Psychiatric Traits*  
Prime Awardee: University of Pennsylvania – Michael Gandal, Ph.D.  
LIBR Subaward PI: Wesley Thompson, Ph.D.  
06/01/2022 – 04/30/2025

### NIH: NIDA

*ABCD-USA Consortium Data Analysis Informatics and Resource Center*  
09/30/2015 – 03/31/2027  
Prime Awardee: University of California San Diego – Anders Dale, Ph.D.  
LIBR Subaward PI: Wesley Thompson, Ph.D.

*Interpretable Deep Forecasting of Hazardous Substance Use During High School*  
09/30/2022 – 08/31/2027  
Prime Awardee: Stanford University – Kilian Pohl, Ph.D.  
LIBR Subaward PI: Wesley Thompson, Ph.D.

*Healthy Brain and Child Development National Consortium Data Coordinating Center*  
07/01/2022 – 06/30/2026  
Prime Awardee: Washington University – Christopher Smyser  
LIBR Subaward PI: Wesley Thompson, Ph.D.

### NIH: National Institute on Alcohol Abuse and Alcoholism (NIAAA)

*NCANDA Data Analytics*  
08/10/2022 – 06/30/2027  
Prime Awardee: Stanford University – Kilian Pohl, Ph.D.  
LIBR Subaward PI: Wesley Thompson, Ph.D.

## 2022 DONORS

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## Grand Addiction Recovery Center (ARC)

Formerly 12&12, Inc., Grand Addiction Recovery Center is the largest Comprehensive Community Addiction Recovery Center in Oklahoma. At Grand ARC, the only focus is to help men and women battle the brain disease of addiction and co-occurring substance abuse/mental health disorders. The complete continuum of care provides multiple levels of treatment including detoxification, intensive residential treatment, outpatient and intensive outpatient treatment, counseling, transitional living, and sober living.

For over 35 years, Grand ARC has helped thousands of Oklahomans in the fight to get their lives back. Their service model is based on a multi-disciplinary approach that integrates medical oversight, psychiatry, nursing, counseling, and case management.

Independently operated and located in the heart of Tulsa, Grand ARC has Behavioral Health Care accreditation from the Joint Commission and is certified by the Oklahoma Department of Mental Health and Substance Abuse Services (ODMHSAS) as a Comprehensive Community Care Addiction Recovery Center (CCARC). For more information on Grand Addiction Recovery Center, Inc. visit [grandaddictionrecovery.com](http://grandaddictionrecovery.com).



**Sahib S. Khalsa M.D., Ph.D.**  
Director of Clinical Operations  
Laureate Institute for Brain Research

**Scott Moseman, M.D.**  
Medical Director  
Laureate Eating Disorders Program

## Laureate Eating Disorders Program Collaboration

The LIBR research team and Laureate Eating Disorders Program (LEDP) reside in the same building on the Laureate campus. This allows for a symbiotic partnership between the research team led by Dr. Sahib Khalsa and the treatment program led by Dr. Scott Moseman.

LEDP strives to provide excellence in eating disorder treatment and care. The research conducted on eating disorders at LIBR aims to inform best care practices. From functional neuroimaging investigations of brain functionality in individuals with eating disorders, to body image therapies and diagnostic evaluation, LIBR remains on the cutting edge of investigation into eating disorder neurobiology and intervention.

When an individual receiving treatment at LEDP qualifies for ongoing research studies, she may be offered the opportunity to participate. The clinical team assists in evaluating how participation will support her recovery and whether the individual might benefit from engaging in the study.

Current areas of research include a treatment study examining the impact of floatation-REST (Reduced Environmental Stimulation Therapy) on body image and anxiety concerns in anorexia nervosa, a neurobiological investigation of the gut-brain connection in anorexia nervosa, and an evaluation of the Tulsa Life Chart, a digital tool that offers an innovative way for patients and providers to visualize, learn, and share about important life events relevant to the individual's eating disorder. LIBR has made important discoveries relevant to individuals struggling with eating disorders as well as to those who love, support, and provide treatment for these individuals.





## Women in Recovery (WIR)

Laureate Institute for Brain Research (LIBR) and Women in Recovery (WIR) have been closely collaborating since 2016 to conduct research that will:

- 1 Determine how the brain recovers from trauma, substance use, depression, and/or anxiety through the unique diversion program, Women in Recovery.
- 2 Identify factors that may predict success within the Women in Recovery program.
- 3 Inform modifications to the program in order to potentially enhance success for future clients.

These goals have been supported by numerous separate but related projects, described below.

### Predictions and Mechanisms of Recovery

This project was conducted as part of the Tulsa 1000 study, and primary investigators on this study include Drs. Paulus and Aupperle. Recruitment has been completed for this project, though longitudinal follow-up assessments are ongoing. A total of 169 women enrolled in the study. Several publications have come from this collaboration in previous years and there continues to be further

insights and manuscripts from this study. One publication in 2022 led by Dr. Ryan Smith reported that individuals with substance use disorders exhibit altered learning rates and less precise action selection when making decisions to explore options versus exploit information gained. Further, learning rates were associated with severity of substance use one year later for stimulant and opioid users. These results were published in the Journal of Computational Psychiatry. In addition, a paper led by Dr. Emily Choquette was submitted

and is currently under review, which reports on the self-report measures collected early in the WIR program that predict subsequent graduation versus withdrawal from the program. These findings point toward several potentially modifiable factors that may be targeted in future studies to enhance treatment. For example, women who graduated tended to report lower impulsivity, greater attention to interoceptive sensations, and greater awareness and willingness to discuss their trauma history. Lastly, Dr. Aupperle presented results at the American College of Neuropsychopharmacology (ACNP), describing how changes in ventral striatum reactivity to reward from baseline to one-year into the WIR program related to changes in impulsivity — suggesting that enhancing neural reactivity to non-drug rewards could be one potential clinical target for future research.

### Neurocognitive Enhancement of Addiction Treatment (NEAT)

This study was funded by the Oklahoma Center for Advancement of Science and Technology (OCAST) and was led by Dr. Ekhtiari and Dr. Aupperle (Co-Investigator). The researchers are utilizing a new group-based therapy called “Brain Gym” focused on the role of neuropsychological functioning (for example, memory, attention, executive functions) in substance use recovery. The intervention uses cartoons, brain awareness games, and real-life scenarios to ensure the intervention is interactive, engaging, and likely to be consolidated. The intervention focuses on how our attention, memory, cognitive control, and ability to monitor what is important (salient) in our environment, as well as our own physical sensations (termed “interoception”), play a role in substance use recovery. This study was completed in 2022; in total 64 women were randomized to complete Brain Gym or treatment as usual at WIR (with 35 randomized to Brain Gym). Investigators are currently in the process of organizing the data collected to support analysis examining potential benefits of the Brain Gym intervention.

### PASO (Plasticity of Aversive Salience in Opioid Addiction) Study

Investigators have completed year two of a five-year grant funded by the National Institute on Drug Abuse examining how the brain, body, behavior, and clinical symptoms (emotional experiences, depression, anxiety, pain) change during early abstinence in men and women with opioid use disorder enrolled in treatment at WIR or Grand Addiction Recovery Center. Participants are recruited into the study and complete neuroimaging scans, behavioral testing, physiology (heart rate, respiration, skin conductance), questionnaires, and interviews at four timepoints: baseline and one-, two-, and three-month follow-up visits. Researchers Dr. Stewart (Principal Investigator), Dr. Kuplicki (Co-Investigator), and Dr. Paulus (Co-Investigator) aim to identify how cognitive, emotional, and physiological responses change as a function of abstinence in early recovery and how these changes compare to controls without a history of opioid use over time. Thus far we have recruited over 80 individuals with opioid use disorder into the PASO study, and data processing is ongoing as we plan to recruit a total of 200 individuals from WIR and Grand Addiction Recovery Center for final analyses.

### Aims for the Future

Dr. Khalsa and Dr. Stewart completed pilot study examining the safety and acute effects of floatation therapy for individuals receiving inpatient treatment for amphetamine use disorder, including women from WIR — which will hopefully inform future NIH grant submissions. In addition, LIBR investigators and staff (Robin Aupperle, Ph.D., Emily Choquette, Ph.D., and Elisabeth Akeman, M.A., LPC) have conducted several focus groups with WIR staff and clients. The aim of these focus groups has been to enhance the clinical-research translation and inform the next stage of collaboration — which will focus on conducting research examining intervention modifications that may enhance outcomes for Women in Recovery.



## Assessment Team



Over the past 10 years, Tim Collins has continued to manage the assessment team as they complete screening assessments and study visits associated with various LIBR research studies. Tim and the team have worked, despite COVID continuing, to accelerate screening numbers to pre-COVID screening totals and beyond. To ensure subject comfort and offer maximum flexibility to the subject, the screening process is now fully remote. This enables the team to screen a multitude of potential subjects without the need for the subject to leave the comfort of their home. This convenience has helped increase the number of screening assessments year by year from 558 in 2020 to 1757 in 2022, an increase of 215%.

The assessment team focuses on three main objectives:

- 1** Recruit participants living in the Northeastern Oklahoma region using a multi-pronged approach, including social media, digital, radio advertising, direct on-site facility recruitment, direct recruitment at the Laureate Psychiatric Clinic and Hospital, and in-person activity-based recruitment.
- 2** Clinically assess participants. Masters-educated interviewers (licensed therapists or licensed social workers) complete diagnostic interviews to determine DSM-5 diagnoses for each participant. Additionally, interviewers discuss current and past suicidal thinking and/or attempts of self-harm with each person. The team completes clinical interviews with adults and teens.
- 3** Medically assess participants. The medical team (registered nurses and medical technicians) complete comprehensive interviews to determine the history of chronic, recent, and current medical conditions.

The assessment team also completes COVID-19 testing as needed, clinical interviews, clinical ratings, blood collections, and assists participants in completing LIBR-based studies for all LIBR investigators.

The assessment team, over the past 3 years (2020-2022), has completed:

Number of phone screens:

11,716

Number of screening consents signed:

3,460

Number of blood collections:

1,390

## Assessment Team Highlights

### Angela Yakshin



After graduating from Oral Roberts University with my bachelor's degree in molecular biology, I joined LIBR as a Research Assistant in 2021. I was then, and still am now, excited and interested in learning about the many different ways to conduct research in the field of mental health. Before my time on the Assessment Team, I worked as a Nurse Technician on the orthopedic unit at Saint Francis Hospital. I have enjoyed the opportunity to compare experiences between each position and even apply some of my clinical experience in my current role. My day-to-day tasks include medical interviews and assessments, coordinating and completing screening and study specific appointments, and completing blood collections for a multitude of LIBR studies. I work closely with our partnering rehab facilities to bring eligible subjects to LIBR for participation in substance use specific studies. I was the sole coordinator for both the NeuroCaps study and the tACS study, responsible for completing all subject study visits and meeting study goals. While at LIBR I have primarily worked with the Substance Use Disorder population; however, I appreciate that I've been able to branch into different populations and studies during my time on the team. This has widened my scope of exposure in a field that I find fascinating and has encouraged me to pursue furthering my education and presence in the medical field.

**Poster Title:** Hyperesthesia in Individuals with Mood and Anxiety Disorders and its Interaction with COVID-19 Diagnosis

**Co-authors:** Angela K. Yakshin, Breanna A. McNaughton, Lindsey A. Bailey, Natosha Markham, Rayus Kuplicki, Tim Collins, Teresa A. Victor, Jonathan Savitz, Sahib S. Khalsa, Robin L. Aupperle, Martin P. Paulus, Jennifer L. Stewart

### Lindsey Bailey



My name is Lindsey Bailey. My journey with LIBR as a Medical Research Assistant started in September of 2020. Prior to transferring to LIBR, I was a Trauma Tech at Saint Francis Hospital's Trauma Emergency Center for five years. At LIBR I have been able to use my clinical skills while also learning new ones. I perform blood draws, coordinate studies with external collaborators (e.g., University of Arkansas and The University of Oklahoma) and have assisted in the medical screening of hundreds of research participants. While at LIBR I also obtained my Basic Life Support Instructor certificate and trained many of the staff members on CPR. Working at LIBR was a total change of pace, but I have loved it! One of my favorite experiences was participating in the first annual LIBR Research Day poster presentation. With the guidance of Dr. Jenny Stewart, I was encouraged to develop my own hypothesis, test that hypothesis, and present my findings. This was a great experience and allowed me to educate the community on the effects of Mental Health and Covid-19. I even won "Fan Favorite"! I have greatly enjoyed my time with LIBR and look forward to what the future holds!

**Poster Title:** The Impact of Mood and Anxiety Disorder Diagnosis on COVID-19 Symptom Severity

**Co-authors:** Lindsey A. Bailey, Breanna A. McNaughton, Angela K. Yakshin, Natosha Markham, Rayus Kuplicki, Tim Collins, Teresa A. Victor, Jonathan Savitz, Sahib S. Khalsa, Robin L. Aupperle, Martin P. Paulus, and Jennifer L. Stewart



2022 William K. Warren Frontiers in Neuroscience Lecture Series Speakers



**Extracellular Vesicles as Systemic Stress Signals and Novel Mechanisms in Neurodevelopment**

Tracy Bale, Ph.D.  
April 5, 2022



**Messing with the Mind: Altering Resting-state Brain Activity to Reduce Perseverative Thinking and Target Mental Disorders**

John Allen, Ph.D.  
May 17, 2022



**Inflammation, Glutamate, and Gila in Depression - Revisited**

Ebrahim Haroon, M.D.  
October 4, 2022



**Why it Matters that a Brain is in a Body**

Karen Quigley, Ph.D.  
September 7, 2022



**Central Mechanisms of the Autonomic System in Health and Disease**

Dr. Karl-Juergen Baer  
November 1, 2022

Diversity in Mental Health Speakers



**Progress and Pitfalls in Multimodal Neuroimaging Signatures of PTSD Susceptibility**

Nathaniel Harnett, Ph.D.  
April 19, 2022



**Biopsychosocial and Behavioral Pathways Connecting Historical Loss to Mental Health in the Blackfeet Community**

Neha John-Henderson, Ph.D.  
April 19, 2022

Visiting Scientists and Distinguished Guests

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Lisa Brown, Ph.D.  
January 25, 2022

**Treating Fear in Real Life Context: Augmented Reality Telepsychiatry Might be the Future of Exposure Therapy**

Arah Javanbakht, M.D.  
July 19, 2022

**Can We Understand Heterogeneity of Depression using Reinforcement Learning?**

Poornima Kumar, Ph.D.  
March 29, 2022

**Studying Maladaptive Value-based Decision Making to Better Understand Clinical Trajectories in Neuropsychiatric Disorders**

Maelle Gueguen, Ph.D.  
September 8, 2022

**Is Bigger Better? Findings from Small Clinical and Big Developmental Cohorts**

Sarah Yip, Ph.D.  
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Scott Mackey, Ph.D.  
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Jennifer Murphy, Ph.D.  
June 29, 2022

**Nature and Neurobiology of Anxiety**

Alex Shackman, Ph.D.  
November 3, 2022



# LIBR Training and Mentoring

**LIBR Accelerated Summer Research (LASR) Internship Program.** Dr. Evan White coordinated LIBR's second annual summer internship program, which enabled students to be full-time paid research interns at LIBR for two months. Interns successfully worked with a lab mentor on developing a research question, analyzing data to answer that question, and presenting their results in a poster format to LIBR staff. Interns also participated in career development workshops with Dr. White and other LIBR staff members.



**Nicole Baughman**, a senior at University of Tulsa majoring in Psychology, worked with **Dr. Evan White** on secondary data analysis of Dr. White's K99 project looking at mental health protective factor

among American Indians (AI). Her project examined neural markers of cognitive control as mechanism of the protective effects of Native American spirituality against generalized anxiety disorder (GAD). Results indicated that individuals with GAD who reported high levels of spirituality demonstrated brain responses during a cognitive control paradigm consistent with healthy individuals, whereas those with low levels of spirituality did not. Results support the utility of understanding neural mechanism of cultural protective features. Nicole continued her work in the lab as a work study student during her senior year and recently applied to Ph.D. programs in Clinical Psychology.



**Sherille Bosfield**, a student finishing up her Master's degree in Clinical Psychology at Pepperdine University, worked with **Dr. Robin Aupperle** on secondary data analysis of a study examining brain

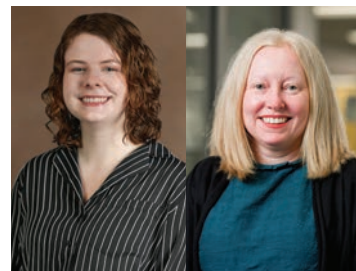
responses during approach-avoidance conflict and changes in these brain responses with psychotherapy

for depression and anxiety. She completed whole-brain analyses that indicated how therapy relates to significant changes in cingulate and anterior insula activation during conflict decisions, with behavioral activation therapy (compared to exposure therapy) relating to increased activation in medical prefrontal cortex. Since completing her M.A. degree, Sherille was hired as a research specialist on LIBR's Adolescent Brain Cognitive Development (ABCD) Study team and is currently applying to doctoral graduate programs in Clinical Psychology.



**Allie Murphy**, a senior at Oklahoma State University majoring in Psychology with a minor in Neuroscience, worked with **Drs. Namik Kirlic & Evan White** on secondary data analysis of the ABCD

study, employing machine learning to clarify the top risk and protective factors for sleep disturbance in adolescents. Results indicated that child and parental internalizing symptoms were among the most impactful predictors of increased sleep disturbance. Such results are important considering sleep quality is a modifiable health factor and impaired sleep is related to a wide range of physical and mental health conditions. Presently Allie is completing her senior year at OSU and applying to Clinical Psychology Ph.D. programs.



**Megan Posey**, a senior at University of Tulsa majoring in Psychology with minors in Education and Health Sciences, was funded by the National Institute on Drug Abuse to work with **Dr. Jennifer Stewart** on preliminary analysis of her R01

study focused on the plasticity of aversive salience in treatment-seeking individuals with opioid use disorder. Megan's results suggested that baseline levels of anhedonia (lack of interest/pleasure in rewarding activities) and negative urgency (taking rash action when in a bad mood) predicted future relapse versus abstinence during the first three months of addiction recovery. Currently, Megan is continuing to work in Dr. Stewart's lab as a work-study student, completing her senior year, and applying to Clinical Psychology Ph.D. programs.

**Diversity in Research And Multidisciplinary Neuroscience (DReaM-Neuro) Post-Baccalaureate Fellowship.** Dr. Evan White and LIBR's Diversity Training and Fellowship Subcommittee created the training and career development plan for the DReaM-Neuro Fellowship supported by LIBR. This fellowship enables a recent college graduate from an underrepresented background to gain up to two years of neuroscientific-based mental health research experience prior to applying for graduate/professional degree programs. Job duties to be undertaken by the fellow may include assisting in experimental design, recruiting participants, administering study sessions, collecting, and analyzing data, and preparing study results for reports, posters, and manuscripts. Funds are made available to the fellow to present their work at conferences and attend other educational training activities. Additionally, DREAM fellows will participate in specialized career development trainings to support their transition to advanced doctoral programs (Ph.D, Psy.D., M.D., or similar), including workshops on preparing competitive applications and navigating interview days.



**Ebony Walker**, LIBR's first DReaM-Neuro fellow, who worked with **Dr. Maria Ironside** on multiple projects, was accepted into Oklahoma State University's Clinical Psychology Ph.D.

program working with Dr. Demond Grant. During her time at LIBR, Ebony presented posters at the Society for Research in Psychopathology and Society for Biological Psychiatry meetings and wrote two papers focusing on emotional regulation. The first paper (published in Current Psychology in 2022) suggested that distraction was associated with increased avoidance under approach-avoidance conflict. The second paper (currently in submission) used cluster analysis to show distinct patterns of emotion regulation dysfunction among individuals with mood and anxiety disorders.



**Lizbeth Rojas** is LIBR's second DReaM-Neuro fellow from Oklahoma City, Oklahoma. She is a first-generation college graduate and received her Bachelor of Science in Psychology with a minor

in Neuroscience from Oklahoma State University in 2022. As an undergraduate student, she worked in the Laboratory of Emotion And Psychophysiology (LEAP) under Dr. DeMond Grant focusing on research in anxiety disorders, with an emphasis on electroencephalography. As a DReaM-Neuro Fellow, she will continue her training on electroencephalography and event-related potentials as part of the Neuroscience of American Indian Resilience and Risk (Neu-AIRR) Lab under the mentorship of Dr. Evan White. Lizbeth plans to obtain her Ph.D. in Clinical Psychology, with an overall goal of working as a neuropsychologist. Currently, her research interests focus on the interrelationship between the body and the brain, and how those connections influence psychopathology and cognitive functions, specifically within depression and anxiety disorders. Overall, she hopes to contribute to improving treatment options, as well as making them more accessible for individuals with mental health difficulties. In her work with Dr. Evan White, Lizbeth is working on a project examining the role of inflammation in disrupted reward processing among AI with major depressive disorder using multi-modal neuroimaging analysis.





# New Post-Doctoral Associates



**Dr. Hannah Berg** earned her Ph.D. in 2022 from the University of Minnesota, focusing on neural substrates of conditioned fear and maladaptive avoidance in clinical anxiety. Dr. Berg joined LIBR in 2021 for her clinical internship and began postdoctoral work with Dr. Robin Aupperle in 2022. Dr. Berg's research at LIBR centers on functional magnetic resonance imaging (fMRI) investigations of decision-making in clinical anxiety, including the impact of behavioral interventions on neural and behavioral responses to approach-avoidance conflict.



**Dr. Cassandra Sturycz-Taylor** earned her Ph.D. in Clinical Psychology from the University of Tulsa, focusing on the psychophysiology of pain in those with a history of self-harm. Dr. Sturycz-Taylor joined LIBR in December 2021 to work with Dr. Robin Aupperle on her RO1, working as a therapist delivering empirically supported treatments for comorbid anxiety and depression disorders as well as with Drs. Aupperle and Paulus in the administration of the Adolescent Brain Cognitive Development (ABCD) Study.



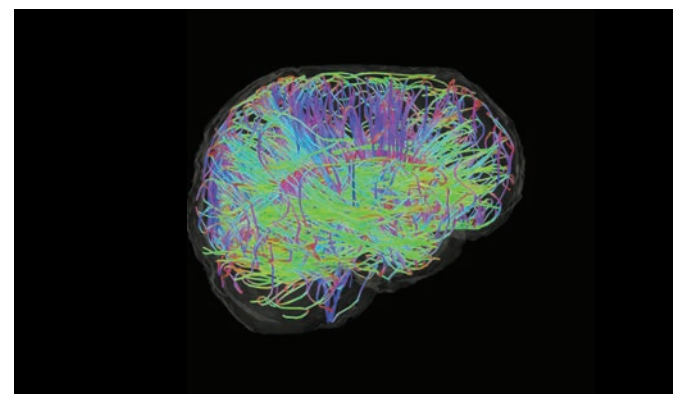
**Dr. Soumyabrata Munshi** earned his Ph.D. in Neuroscience from the Rosalind Franklin University of Medicine and Science, focusing on understanding the changes in basolateral amygdala physiology during peripheral immune challenge and stress using animal experimental models. Dr. Munshi joined LIBR in February 2022 to work with Dr. Jonathan Savitz on investigating the expression changes of the genes related to mitochondrial biogenesis, endoplasmic reticulum stress, and inflammasome activation in peripheral blood mononuclear cells (PBMCs) of patients with major depressive disorder using molecular biology technique.



**Dr. Ricardo Wilhelm** earned his Ph.D. in Experimental Psychology from the University of Alabama at Birmingham, focusing on electroencephalographic (EEG) measures of motivation, including frontal alpha band asymmetry and beta band suppression. Dr. Wilhelm joined LIBR in January 2021 to work with Dr. Jennifer Stewart and Dr. Evan White on EEG frequency, event related potential, and functional magnetic resonance imaging (fMRI) research focused on American Indian health disparities as well as motivation, reward, and cognitive control processing in mood/anxiety and substance use disorders.



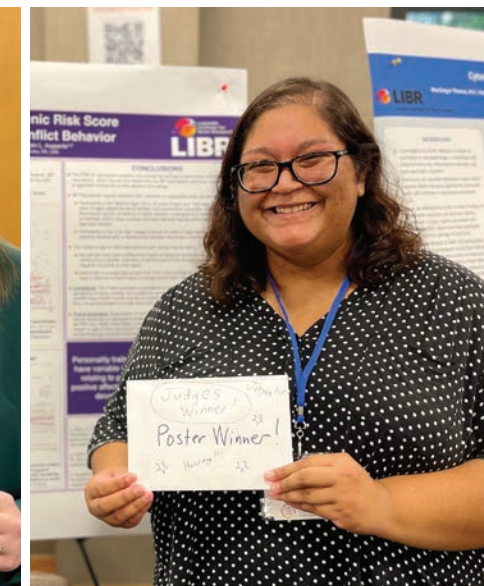
**Dr. Hyejin Shim** earned her Ph.D. in Statistics, Measurement, and Evaluation in Education with a minor in Statistics from the University of Missouri, focusing on developing and evaluating alternatives to the traditional statistical models used in item response theory (IRT) and in applying IRT methods to validate data in various fields. Dr. Shim joined LIBR in June 2022 to work with Dr. Martin Paulus on repeated negative thinking with specific focus on a) psychopathology and its measurement, b) the underlying neuroscience, and c) the impact of interventions and/or subgroups.



# LIBR Research Day



On October 28, 2022 LIBR held its first annual Research Day open to the public, wherein 20 research assistants presented posters on research they conducted within their respective labs at LIBR. Internal LIBR judges reviewed all posters and scored them on various criteria, and all in attendance were encouraged to vote for their favorite poster. Lindsey Bailey won the "Crowd Favorite" poster award, focused on "The Impact of Mood and Anxiety Disorder Diagnosis on COVID-19 Symptom Severity", and Jaya Chakka won the "Judges' Favorite" poster award, focused on "Examination of Relationships between Polygenic Risk Score for Neuroticism and Approach-Avoidance Conflict Behavior". LIBR's Research Day gave research assistants an opportunity to showcase their hypothesis testing, data analysis, and poster presentation skills, providing additional experience for graduate and medical school applications.







# In the News 2022



## Scientific Retreat 2022

LIBR Investigators gathered at Grand Lake for their 2022 annual scientific retreat. The gathering was a time to reflect on the progress of the institute over the past year and look ahead to future research endeavors through open discussion and engagement.



## “Mental health experts give advice for dealing with traumatic events”

News on 6

[Read the full article.](#)

## “Never wrong to ask for help: Laureate Institute for Brain Research experts offer guidance navigating trauma of Saint Francis mass shooting”

Tulsa World, June, 2022

[Read the full article.](#)

## “Saint Francis mental health providers describe how to deal with trauma following Tulsa mass shooting”

KOCO news 5

[Read the full article.](#)

## “Saint Francis hosts mental health forum on processing traumatic events”

Fox 23 News

[Read the full article.](#)

Drs. Aupperle and Khalsa engaged in discussion concerning strategies for protecting one’s mental health in response to the mass shooting that occurred at the Natalie Medical Building of Saint Francis in July of 2022. Their thoughts were shared via numerous local news outlets, including News on 6, KOCO News 5, Fox 23 News, and the Tulsa World.

Dr. Khalsa was interviewed for an article on interoception by the Wall Street Journal entitled “The Emotional Toll When We Misread What Our Bodies Are Telling Us” By Kate Murphy

[Read the full article.](#)



Illustration: Yunyi Dai



Dr. Aupperle shared research and advice concerning how youth and adults can optimize their mental health in response to major life transitions, such as moving to a new school or starting college: “Transitions Require Communication and a Listening Ear” *TulsaKids magazine*

[Read the full article.](#)

Dr. Khalsa was interviewed for an article on his research related to floatation therapy and interoception by New Scientist entitled “Interoception: This ‘sixth sense’ could be key to better mental health” By Caroline Williams

[Read the full article.](#)



Illustration: Brett Ryder



Dr. Khalsa was interviewed for the Gastronomers podcast during a visit to Duke University.

[Listen to the podcast.](#)



About this Attention Score

In the top 5% of all research outputs scored by Altmetric

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Mentioned by

- 17 news outlets
- 251 tweeters
- 3 Facebook pages
- 1 Redditor

A paper from the Khalsa lab, first authored by LIBR postdoctoral scholar Adam Teed, in JAMA Psychiatry was covered by numerous news outlets. [Learn more.](#)

[LIBR press release](#)

[UCLA press release](#)

[Medical News Today](#)

[EurekAlert!](#)



Dr. Sahib Khalsa was invited to speak for the “Meet the Scientist” feature with the **Brain & Behavior Research Foundation** where he discussed how interoception is critical to understanding how crosstalk between the gut and brain influences eating disorders.

[Read the full article.](#)



## Feature Story

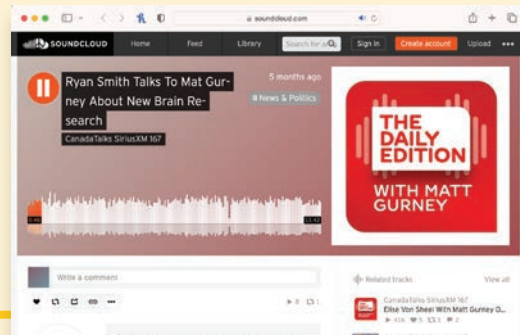
NIMHD's Conversations with Researchers Advancing Health Equity

**Evan J. White, Ph.D.**  
Principle Investigator  
Director, Native American Research  
Director, Electroencephalography Core  
Laureate Institute for Brain Research (LIBR)

#NativeAmericanHeritageMonth



As the director of Native American Research at the Laureate Institute for Brain Research, Dr. Evan White was interviewed by the National Institute on Minority Health and Health Disparities (NIMHD) for American Indian and Alaska Native Heritage Month in November. In this article, NIMHD's conversation with Dr. White delves into his research goals, leadership and mentorship of future generations of scientists, as well as future directions for his own research.



Dr. Ryan Smith Talked To Matt Gurney About New Brain Research. Daily Edition with Matt Gurney

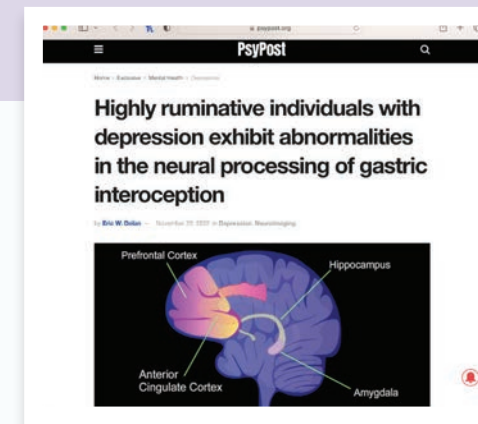
CanadaTalks SiriusXM 167. September 2022

[Listen to the episode.](#)

Dr. Ryan Smith published an article in Frontiers in Psychiatry on information-seeking and cognitive reflection in depression and anxiety.

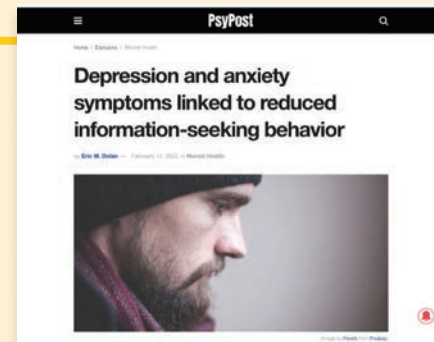
Depression and anxiety symptoms linked to reduced information-seeking behavior February 14, 2022. *PsyPost*

[Read the full article.](#)



Dr. Salvador Guinjoan was interviewed by **PsyPost - Psychology Research News** about his recent senior author publication “Attenuated interoceptive processing in individuals with MDD and high repetitive negative thinking”.

[Read the full article.](#)



Dr. Ryan Smith shared new research in his lab that there may be important differences in how individuals with substance use disorders learn from negative outcomes.

Why Some Keep Using Drugs, Even Knowing It Ruins Their Lives: A reason to show them more empathy, not less. (2022). *Psychology Today*

[Read the full article.](#)

How Anxiety and Depression May Interfere With Decision-Making (2022). *Psychology Today*

[Read the full article.](#)

Do Emotions Help or Hinder Rational Thinking? (2022). *Psychology Today*

[Read the full article.](#)

Drs. Martin Paulus and Salvador Guinjoan were interviewed by Tulsa's **LIFE Senior Services** for their October issue “The Brain Game”. Learn about the latest science on brain health, neuroplasticity, effects of exercise on the brain, and the heart-brain connection.

[Read the full article.](#)





## JAMA Network™

Co-authors Wes Thompson and Chun Chieh Fan published new research in **JAMA Neurology**. Their research shows that individuals with two copies of a gene mutation (one inherited from each parent) show evidence of substantial iron buildup in regions of the brain responsible for movement.



Dr. Samuel Taylor, from the laboratory of Dr. Martin Paulus, was awarded a National Science Foundation Graduate Research Fellowship.



LIBR partnered with Tulsa's Young Professionals Diversity Crew to host an important conversation at LIBR focused on diversity in mental health, both in the community and in research.



LIBR welcomed the **Oklahoma Center for Community and Justice (OCCJ)** for workshops on "Communication Best Practices & Civil Conversations" to promote diversity, equity and inclusion in the workplace.



Dr. Philip Spechler received a highly competitive 2022 Travel Award for Early Career Investigators from The College on Problems of Drug Dependence (CPDD). The award provided funding to attend the CPDD annual meeting held June 11-15 in Minneapolis, MN.



Dr. Leandra Figueroa-Hall was selected for the **National Institutes of Health (NIH)** MOSAIC Program awarded through NIMH! Her research focuses on "In vivo inflammatory challenge to elucidate the role of the toll-like receptor 4 pathway in depression".

The goal of the Maximizing Opportunities for Scientific and Academic Independent Careers (MOSAIC) program is to equip scholars with professional skills, mentoring and networks to facilitate transition in successful independent academic careers at research-intensive institutions.

The program funds up to two years of mentored postdoctoral career development and up to three years of independent research in a faculty position (K99/R00).

Dr. Martin Paulus joined the 2022 Board of Directors of the Anxiety and Depression Association of America (ADAA). The board members are distinguished researchers, clinicians, and psychiatrists serving the public and mental health community.







## LIBR Principal Investigator Highlight

**DRS. WESLEY K. THOMPSON AND CHUN-CHIEH FAN**  
Principal Investigators  
Laureate Institute for Brain Research

### Wesley K. Thompson, Ph.D.

As an undergraduate Wesley Thompson attended the University of Chicago, where he received his BS in Mathematics in 1991. In 1995 he received an MS in Mathematics at the State University of New York, Albany, after which he worked for two years as a property and casualty actuary in New York City. He returned to graduate school at Rutgers, the State University of New Jersey, receiving his Ph.D. in Statistics in 2003 under his thesis advisor Professor Ming Xie, specializing in methods for longitudinal data analysis.

Wes' first academic position following graduate school was as Assistant Professor of Statistics and Psychiatry at the University of Pittsburgh (2004-2008), where he obtained an NIH K25 mentored career award (**K25MH076981** "Modeling Dynamic Variation of Brain

Function, Health and Symptoms in Depression). From there Wesley moved to the University of California, San Diego, attaining the rank of Professor in Residence in 2019. While at UCSD, Wesley took a two-year leave of absence (2015-2017) to live and work in Copenhagen, Denmark, at the Institute for Biological Psychiatry, with which he still maintains close ongoing collaborations. In 2022, Wesley joined Laureate Institute for Brain Research to form the Center for Population Neuroscience and Genetics with his longtime colleague, Dr. Chun-Chieh Fan. Wesley and Chun are planning the center to be a hub for analyzing large-scale imaging and genomic data.

Wesley is currently the Associate Director of the Data Analysis and Informatics Resource Center (DAIRC) in Charge of Consortium Biostatistics, for the Adolescent

Brain Cognitive Development study (<https://abcdstudy.org/>). The ABCD Study, a landmark study on brain development and child health supported by the NIH, is a consortium with 21 sites across the USA studying nearly 12,000 participants (aged 9-10 at baseline) for 10 years, with funding of well over \$500 million over the course of the study. Additionally, Wesley is the Director of Biostatistics for another adolescent brain imaging national consortium, The National Consortium on Alcohol and Neurodevelopment in Adolescence (NCANDA, <http://ncanda.org/>). This is a five-site cohort sequential study of more than 800 subjects whose purpose is to determine the effects of alcohol use on the developing adolescent brain and examine brain characteristics that predict alcohol use problems. Finally, he is also the Director of Biostatistics on a new NIH study with 25 sites — the Healthy Brain and Child Development (HBCD) Study (<https://heal.nih.gov/research/infants-and-children/healthy-brain/>), which will be of equal size and scope as the ABCD Study, and began funding as of September 2021.

Wesley is currently interested in the development and application of Bayesian models and causal inference to longitudinal, population-level brain imaging and genomic datasets, particularly semi-parametric approaches that incorporate expert knowledge while allowing the data to "speak for themselves".

### Chun Chieh Fan, M.D., Ph.D.

Chun grew up in Taiwan during the historical junction when Taiwan transitioned from authoritarian regime to democratic government. He attended the medical school of National Yang-Ming University, Taiwan, and completed his psychiatry residency at Taipei City Psychiatric Center, Taiwan. The training and the following years of clinical practice in adult psychiatry deepened Chun's interest in understanding the etiology of psychiatric disorders. Therefore, he moved to the United States to have formal training in cognitive neuroscience and bioinformatics. In 2017, he graduated with Ph.D. in cognitive science from the University of California, San Diego. Under the mentorship of Anders

Dale and Terry Jernigan, Chun worked on genomics and neuroimaging, examining the molecular basis of the factors that shape the human brain.

After graduation, Chun initially worked as a bioinformatician in both biomedical industry and academic settings. He later joined the Department of Radiology at the University of California, San Diego, as an Assistant Professor. At the same time, the Adolescent Brain Cognitive Development (ABCD) Study, a seminal large-scale imaging genomic study on the development of the adolescent brain and mind from 21 sites across United States, was in its building stage. Chun became an essential member of the bioinformatics team, chairing the genetic working group of ABCD and establishing a series of bioinformatics pipelines for enhancing the ABCD data.

Chun is particularly interested in the idea of endophenotypes. Endophenotype means a phenotype that is closely related to the underlying molecular pathways and, therefore, is determined mainly by one's inherited genes. Despite its usefulness as a concept, the empirical evidence and its utilities are less tested. Chun and his team members utilized the flexibility of multi-modal neuroimaging and the molecular information associated with the genetic variants to apply novel methods to extract endophenotypes of human brain and examine their relationships to human brain disorders.

Because the scope of Chun's research involves extensive analyses of population scale datasets, it requires a substantial amount investment in data scientists, data infrastructure and computational resources. In 2022, Chun decided to join Laureate Institute for Brain Research to form the Center for Population Neuroscience and Genetics with his longtime colleague, Dr. Wesley K. Thompson. Chun and Wesley envision the center will be the hub for analyzing large-scale imaging and genomic data, pushing the scientific boundaries in understanding the etiology of human brain disorders.



## ROBIN AUPPERLE, PH.D.

Principal Investigator,  
Laureate Institute for Brain Research  
Associate Professor, Oxley College  
of Health Sciences, The University of Tulsa  
Volunteer Faculty Member,  
Department of Psychiatry,  
The University of Oklahoma



## Research Highlights

- 1** In persons with Major Depressive Disorder, repetitive negative thinking (RNT, including symptoms like rumination or worry) results in a worsened prognosis; the group has confirmed RNT is a major predictor of suicidal thinking and behavior in outpatients with a variety of psychiatric disorders.
- 2** The NeuroCATT lab collaborated with Dr. Charles Taylor at the University of California, San Diego and Dr. Kate Wolitzky-Taylor at the University of California, Los Angeles on a feasibility and pilot study of an intervention focused on enhancing positive emotions and social connections and reducing alcohol use for individuals with alcohol use disorder and symptoms of anxiety or depression. Results of this pilot study (led by first author Elisabeth Akeman) were published in the journal Behavior Modification. A follow-up R34 developmental grant was submitted to the National Institute on Alcohol Abuse and Alcoholism (NIAAA) and is currently under consideration for funding.
- 3** When the COVID pandemic began, Dr. Aupperle's laboratory added measures concerning COVID to an ongoing, longitudinal study focused on the effects of resilience training for college students. Dr. Aupperle and Ms. Akeman published findings this year in Frontiers of Psychology indicating how self-reported mental health symptoms, on average, worsened through the pandemic. Those reporting increases in depression symptoms were more likely to be female, from minority races/ethnicities, and have lower incomes prior to the pandemic. When matched on demographics, individuals who exhibited resilience to the mental health impacts of COVID reported lower levels of alcohol use prior to the pandemic and more use of active coping strategies.
- 4** Dr. Aupperle completed data collection for a pilot study funded by Center of Biomedical Research Excellence (CoBRE) for Neuroscience-Based Mental Health Assessment and Prediction (NeuroMAP). This pilot study examined neural and behavioral responses associated with positive future thinking and how these responses may be different for individuals experiencing depression who are or are not at high risk for suicide (i.e., history of suicide attempts and current suicidal ideation), with the aim of informing future neuroscience-informed interventions aiming to enhance hope and reduce suicide risk.



### LAB MEMBERS

**ELISABETH AKEMAN**  
Research Therapist

**SONALEE JOSHI**  
Clinical Psychology Intern

**HANNAH BERG, PH.D.**  
Post-Doctoral  
Research Associate

**EMILY CHOQUETTE, PH.D.**  
Post-Doctoral  
Research Associate

**XIAOQIAN YU, PH.D.**  
Post-Doctoral  
Research Associate

**JAYA CHAKKA**  
Lab Coordinator

**KELLY COSGROVE**  
Graduate Student,  
The University of Tulsa

**TIM MCDERMOTT**  
Graduate Student,  
The University of Tulsa

**SAMANTHA RAMIREZ**  
Research Assistant

**AARDRON ROBINSON**  
Software Engineer

## Current Research Focus

Dr. Aupperle is Principal Investigator at Laureate Institute for Brain Research (LIBR) and Associate Professor at The University of Tulsa. She currently serves as Chair of LIBR's Diversity, Equity, and Inclusion Committee and Director of the LIBR training site for the Northeastern Oklahoma Psychology Internship Program (NOPIP; <https://www.nopip.org>). Her research focuses on using neurocognitive methods to enhance our understanding of anxiety, depression, and trauma. She is particularly interested in (1) the intersect between cognitive and emotional processing and decision-making and how this may relate to the development and maintenance of anxiety, depression, and trauma-related symptoms and (2) how knowledge from neuroscientific research may be used to enhance treatment and prevention efforts.

### Select Publications

- McDermott, T.J., Berg, H., Touthang, J., Akeman, E., Cannon, M.J., Santiago, J., Cosgrove, K.T., Clausen, A.N., Kirlic, N., Smith, R., Craske, M.G., Abelson, J.L., Paulus, M.P., Aupperle, R.L. (2022). Striatal reactivity during emotion and reward relates to approach-avoidance conflict behaviour and is altered in adults with anxiety or depression. *Journal of Psychiatry and Neuroscience*, 47: 5, pp. E311-E322.
- Akeman, E., Cannon, M.J., Kirlic, N., Cosgrove, K.T., DeVille, D., McDermott, T.J., White, E.J., Cohen, Z.P., Forthman, K.L., Paulus, M.P., and Aupperle, R.L. (2022). Active coping strategies and less pre-pandemic alcohol use relate to college student mental health during the COVID-19 pandemic. *Frontiers in Psychology*, 13: 926697.
- Kirlic, N., Kuplicki, R., Touthang, J., Cohen, Z.P., Stewart, J.L., Bodurka, J., Khalsa, S.S., Guinjoan, S., Savitz, J., Victor, T.A., Paulus, M.P., Aupperle, R.L. (2022). Behavioral and Neural Responses during Fear Conditioning and Extinction in a Large Transdiagnostic Sample. *NeuroImage: Clinical*, 35, p.103060.
- Cosgrove, K.T., McDermott, T.J., White, E.J., Mosconi, M.W., Thompson, W.K., Paulus, M.P., Cardenas-Iniguez, C., Aupperle, R.L. Limits to the generalizability of resting-state functional magnetic resonance imaging studies of youth: An examination of ABCD Study\* baseline data. *Brain Imaging Behav.* 2022 Aug;16(4):1919-1925.
- White, E.J., Demuth, M.J., Wiglesworth, A., Coser, A.D., Garrett, B.A., Kominsky, T.K., Jernigan, V., Thompson, W.K., Paulus, M., & Aupperle, R.L. (2022). Five recommendations for using large-scale publicly available data to advance health among American Indian peoples: the Adolescent Brain and Cognitive Development (ABCD) StudySM as an illustrative case. *Neuropsychopharmacology*.



## CHUN-CHIEH FAN, M.D., PH.D.

Principal Investigator,  
Laureate Institute for Brain Research

Research Associate Professor, Oxley College  
of Health Sciences, The University of Tulsa



## Research Highlights

- 1 Dr. Fan obtained NIH R01 funding as the contact PI for a multiple PI grant to investigate the impact of social disruption during the pandemic period among adolescents. This funded project will utilize novel causal inference methods to understand how social factors shape brain development and examine resilience/risk factors associated with social isolation.
- 2 In a collaboration at the University of California, San Diego, Dr. Fan and post-doc Robert Loughnan investigated the associations between brain specific iron cumulations and neurodegenerative disorders. They found that the motor pathways of the human brain are particularly susceptible to the disruption of iron metabolism. The results were published in JAMA Neurology.
- 3 To raise the awareness of the biases and confounds in large scale imaging studies, Dr. Fan presented his work on the associations between population stratifications and imaging measurements at this year's FLUX meeting in Paris, France. Without considering the confounds in the study cohort with heterogeneous backgrounds, analyzing the neuroimaging measurements can lead to substantial bias and erroneous interpretations.

### Current Research Focus

Dr. Fan develops and applies novel analytic approaches to large-scale population level data to understand the factors that shape the development of the human brain and the manifestation of brain disorders. He uses genomic data as the instrumental variables for molecular processes and explores their associations with imaging and diagnostic outcomes. By finding the connections across data in macro, meso, and micro scales, Dr. Fan and his team strive to find the potential candidates for psychiatric interventions to facilitate mental well-being.

### Select Publications

1. Robert Loughnan, Jonathan Ahern, Cherisse Tompkins, Clare E Palmer, John Iversen, Wesley K Thompson, Ole Andreassen, Terry Jernigan, Leo Sugrue, Anders Dale, Mary ET Boyle, **Chun Chieh Fan**. Association of Genetic Variant Linked to Hemochromatosis With Brain Magnetic Resonance Imaging Measures of Iron and Movement Disorders. *JAMA Neurology*; 2022; 79 (9), 919-928.
2. Shi-Heng Wang, Chi-Shin Wu, Le-Yin Hsu, Mei-Chen Lin, Pei-Chun Chen, Wesley K Thompson, **Chun-Chieh Fan**. Paternal age and 13 psychiatric disorders in the offspring: a population-based cohort study of 7 million children in Taiwan. *Molecular Psychiatry*; 2022; 1-11.
3. **Chun Chieh Fan**, Robert Loughnan, Carolina Makowski, Diliana Pecheva, Chi-Hua Chen, Donald J Hagler, Wesley K Thompson, Nadine Parker, Dennis van der Meer, Oleksandr Frei, Ole A Andreassen, Anders M Dale. Multivariate genome-wide association study on tissue-sensitive diffusion metrics highlights pathways that shape the human brain. *Nature communications*; 2022; 13 (1), 1-10
4. Robert J. Loughnan, Clare E. Palmer, Carolina Makowski, Wesley K. Thompson, Deanna M. Barch, Terry L. Jernigan, Anders M. Dale, **Chun Chieh Fan**. Unique prediction of developmental psychopathology from genetic and familial risk. *The Journal of Child Psychology and Psychiatry*. 2022.
5. Junting Ren, Susan Tapert, **Chun Chieh Fan**, Wesley K Thompson. A semi-parametric Bayesian model for semi-continuous longitudinal data. *Statistics in Medicine*. 2022; 41 (13), 2354-2374

### LAB MEMBERS

#### BOHAN XU, PH.D.

Data Scientist at LIBR

#### ROBERT LOUGHNAN, PH.D.

Post-Doctoral Fellow at UCSD

#### JUNTING REN

Graduate student at UCSD

#### LUCY SHAO

Graduate student at UCSD

#### WENJIE CHENG

Staff programmer at UCSD



## LEANDRA K. FIGUEROA-HALL, PH.D.

Associate Investigator,  
Laureate Institute for Brain Research  
Research Assistant Professor, Oxley College  
of Health Sciences, The University of Tulsa



### LAB MEMBER

**CIBONEY WARE**  
Mentee, LIBR ABCD Research Assistant

## Research Highlights

- 1** Dr. Figueroa-Hall's five-year K99/R00 Maximizing Opportunities for Scientific and Academic Independent Careers (MOSAIC-NIGMS) grant, entitled "In vivo inflammatory challenge to elucidate the role of the toll-like receptor 4 (TLR4) pathway in depression", was funded by the National Institute of Mental Health in April 2022 (K99MH126950). This career training grant aims to 1) provide additional training to scientists with diverse backgrounds developing careers at research-intensive institutions; and 2) examine the role of TLR4 inflammatory signaling in Major Depressive Disorder.
- 2** Dr. Figueroa-Hall's collaboration with Dr. Kaiping Burrows has led to the advancement in brain enriched extracellular vesicle (EV) research at LIBR, specifically investigating neuronal- and astrocyte-enriched EVs in mental health research. The study of brain-enriched (EVs) provides a unique, and possibly, revolutionary approach to examine brain biology from a blood sample.
- 3** Dr. Figueroa-Hall has presented her research at international and national conferences in 2022: Oral presentation for the International Society for Extracellular Vesicles (ISEV; Lyon, France- May 2022); Poster presentation for ISEVxTECH (Honolulu, Hawaii- November 2022); and Data Blitz and poster presentation for the American College of Neuropsychopharmacology (Phoenix, AZ- December 2022).

### Current Research Focus

Dr. Figueroa-Hall's training and expertise in toll-like receptor 4 (TLR4) inflammatory signaling is the basis for her research interests in examining how the TLR4 system via regulating inflammatory processes affects mental health. Her overarching goal is to understand how the immune system is dysregulated in MDD and identify novel targets/biomarkers for inflammation-associated depression. Her current research aims include investigating peripheral and central immune responses in depressed vs. healthy individuals and delineating astrocyte-enriched EV-mediated immune mechanisms in MDD. Dr. Figueroa-Hall is also involved in LIBR's Diversity, Equity, and Inclusion Committee and the Philanthropy/Community Outreach Subcommittee.

### Select Publications

- 1. Figueroa-Hall LK, Xu B, Kuplicki R, Ford BN, Burrows K, Teague TK, Sen S, Yeh HW, Irwin MR, Savitz J, Paulus MP. Psychiatric symptoms are not associated with circulating CRP concentrations after controlling for medical, social, and demographic factors. Transl Psychiatry. 2022 Jul 12;12(1):279. doi: 10.1038/s41398-022-02049-y. PMID: 35821205; PMCID: PMC9276683.*
- 2. Zheng H, Teague TK, Yeh FC, Burrows K, Figueroa-Hall LK, Aupperle RL, Khalsa SS, Paulus MP, Savitz J. C-Reactive protein and the kynurenic acid to quinolinic acid ratio are independently associated with white matter integrity in major depressive disorder. Brain Behav Immun. 2022 Oct;105:180-189. doi: 10.1016/j.bbi.2022.07.011. Epub 2022 Jul 16. PMID: 35853557.*
- 3. Burrows K, Figueroa-Hall LK, Kuplicki R, Stewart JL, Alarbi AM, Ramesh R, Savitz JB, Teague TK, Risbrough VB, Paulus MP. Neuronally-enriched exosomal microRNA-27b mediates acute effects of ibuprofen on reward-related brain activity in healthy adults: a randomized, placebo-controlled, double-blind trial. Sci Rep. 2022 Jan 17;12(1):861. doi: 10.1038/s41598-022-04875-y. PMID: 35039595; PMCID: PMC8764091.*

### Abstracts

- 1. Leandra K. Figueroa-Hall, Kaiping Burrows, McGregor Thomas, Rayus Kuplicki, T. Kent Teague, Rajagopal Ramesh, Michael R. Irwin, Victoria B. Risbrough, Sahib Khalsa, Salvador Guinjoan, Martin P. Paulus, Jonathan Savitz. Toll-like Receptor 4 Agonist Elicits an Inflammatory Response After Immune Challenge in Major Depressive Disorder. ACNP; December 2022.*
- 2. Leandra K. Figueroa-Hall, Kaiping Burrows, Ahlam M. Alarbi, Chibing Tan, Bethany Hannafon, Rajagopal Ramesh, Jennifer L. Stewart, Jonathan Savitz, Victoria B. Risbrough, T. Kent Teague, Martin P. Paulus. Comparison of next-generation sequencing data analysis on astrocyte-enriched extracellular vesicles using different platforms. ISEVxTECH; November 2022.*
- 3. Leandra K. Figueroa-Hall, Kaiping Burrows, Ahlam M. Alarbi, Chibing Tan, T. Kent Teague, Brett McKinney, Rajagopal Ramesh, Yoon-Hee Cha, Salvador Guinjoan, Sahib Khalsa, Victoria B. Risbrough, Martin P. Paulus, Jonathan Savitz. Changes in human astrocyte-enriched extracellular vesicle miRNAs after an in vivo lipopolysaccharide challenge. ISEV 2022; May 2022.*



## SALVADOR M. GUINJOAN, M.D., PH.D.

Principal Investigator,  
Laureate Institute for Brain Research

Research Associate Professor, Oxley College  
of Health Sciences, The University of Tulsa



### LAB MEMBER

STELLA SANCHEZ, PH.D.

Post-Doctoral Research Fellow

## Research Highlights

- 1** In persons with Major Depressive Disorder (MDD), repetitive negative thinking (RNT, including symptoms like rumination or worry) results in a worsened prognosis and heightened risk of suicide. The group has investigated the neurobiological mechanisms of RNT generation and maintenance in MDD.
- 2** Fear learning abnormalities (but not reward processing) and interoceptive deficits are characteristic of persons with MDD and high RNT.
- 3** In resting conditions, RNT seems to be characterized by heightened functional connectivity between brain areas responsible for semantics like the right temporoparietal junction and emotional salience (especially anterior insular cortex).
- 4** A pilot employing low-intensity focused ultrasound and targeting cortico-subcortical limbic circuits to decrease RNT has started after FDA revision and bioethical approval.

### Current Research Focus

Dr. Guinjoan's lab strives to discover and characterize circuits that subservise RNT in persons with depression. After characterizing functional and circuits, they established that persons with intense RNT display specific changes in the disposition and size of white matter tracts connecting psychosurgical targets useful in MDD and obsessive compulsive disorder. This work is now being followed by an attempt to directly modulate such circuits employing low-intensity focused ultrasound (LIFU), an emerging reversible and noninvasive technique of neuromodulation. If successful, this experiment may pave the way to larger trials addressed at 1) establishing causal relationships between large-scale brain circuits and an important symptom of MDD, and 2) attempting to alleviate RNT in a safe, noninvasive manner.

### Select Publications

1. Tsuchiyagaito A, Sanchez SS, Misaki M, Kuplicki R, Park H, Paulus MP, **Guinjoan SM** (2022): Intensity of repetitive negative thinking in depression is associated to greater functional connectivity between semantic processing and emotion regulation areas. *Psychological Medicine*, 31: 1-12.
2. Park H, Kirlic N, Kuplicki R, Tulsa 1000 Investigators, Paulus M, **Guinjoan SM** (2022): Neural processing dysfunctions during fear learning but not reward-related processing characterize depressed individuals with high levels of repetitive negative thinking. *Biological Psychiatry: Cognitive Neuroscience and Neuroimaging* 7(7): 716-724.
3. Park H, Sanchez SM, Kuplicki R, Tsuchiyagaito A, Khalsa SS, Paulus MP, **Guinjoan SM** (2022): Attenuated interoceptive processing in individuals with major depressive disorder and high repetitive negative thinking. *Journal of Psychiatric Research* 156: 237-244.
4. Fiorito AM, Aleman A, Blasi G, Bourque J, Cao H, Chan RCK, Chowdury A, Conrod P, Diwadkar VA, Goghari VM, **Guinjoan SM**, Gur RE, Gur RC, Kwon JS, Lieslehto J, Lukow PB, Meyer-Lindenberg A, Modinos G, Quarto T, Spilka MJ, Shivakumar V, Venkatasubramanian G, Villarreal M, Wang Y, Wolf DH, Yun J-Y, Fakra E, Sescousse G (2022): Are brain responses to emotion a reliable endophenotype of schizophrenia? An image-based fMRI metaanalysis. *Biological Psychiatry*, in press.



## MARIA IRNSIDE, DPHIL

Associate Investigator,  
Laureate Institute for Brain Research

Assistant Professor, Oxley College  
of Health Sciences, The University of Tulsa



## Research Highlights

- 1 The lab utilized multi-level (self-report, behavioral, electromyography, and functional neuroimaging) data from the Tulsa 1000 study to characterize threat sensitivity as a potential unique phenotype of anxious depression, resulting in two papers currently under revision and a further one in preparation. These data informed an R01 federal funding application submitted in Summer 2022, which received positive reviews. If the funding is confirmed, the project has a planned start date of Summer 2023.
- 2 The lab is currently in year two of three-year NIGMS funded project focusing on the effects of non-invasive brain stimulation on threat sensitivity in anxious depression.
- 3 Research assistant Ebony Walker successfully completed her Diversity in Research and Multidisciplinary Neuroscience (DReaM-Neuro) Post-Baccalaureate Fellowship in the lab and was successful in obtaining a competitive place in the Clinical Psychology Ph.D. program at Oklahoma State University.

### Current Research Focus

Dr. Ironside has a background in cognitive neuroscience with a focus on neuromodulation and neuroimaging in clinical populations. Her main interests include establishing unique targetable phenotypes of anxious depression and understanding the mechanisms of action of novel treatments such as non-invasive neuromodulation. Dr. Ironside uses behavioral, electrophysiological and neuroimaging measures to investigate acute effects of treatments such as transcranial direct current stimulation with a view to establishing potential biomarkers of treatment response. The goal of this research program is to identify novel treatment targets, inform patient selection for future clinical trials and, ultimately, treatment selection in the clinic.

### Select Publications

1. Walker, EA, Aupperle, RL, T1000 Investigators, Paulus, MP, Ironside, M. (In press) Distraction is associated with increased avoidance behavior under approach-avoidance conflict. *Current Psychology*.
2. Ironside, M, et al. (2021) Reductions in rostral anterior cingulate GABA are associated with stress circuitry in females with major depression: A multimodal imaging investigation. *Neuropsychopharmacology*.
3. Ironside M\*, Amemori K\*, McGrath CL, Lund Pedersen M, Kang MS, Amemori S, Frank MJ, Graybiel AM, Pizzagalli DA. (2020) Approach-avoidance conflict in major depression: Congruent neural findings in human and non-human primates. *Biol Psychiatry*. 2020;87:399-408.
4. Ironside M, Browning M, Ansari LN, Harvey CJ, Sekyi-Djan MN, O'Shea J, Bishop S, Harmer CJ. (2019) Effect of prefrontal cortex stimulation on regulation of amygdala response to threat in individuals with trait anxiety: A randomized clinical trial. *JAMA Psychiatry*. 2019;76:71-78.
5. Ironside M, O'Shea J, Cowen PJ, Harmer CJ (2016) Frontal cortex stimulation reduces vigilance to threat: Implications for the treatment of depression and anxiety. *Biol Psychiatry*. 2016;79: 823-830.

## LAB MEMBERS

TATE POPLIN  
Research Assistant





## SAHIB KHALSA, M.D., PH.D.

Director of Clinical Operations,  
Laureate Institute for Brain Research

Associate Professor,  
Oxley College of Health Sciences,  
The University of Tulsa

Director, LIBR Float Clinic and  
Research Center

Volunteer Faculty Member,  
Department of Psychiatry,  
The University of Oklahoma



## Research Highlights

- 1** Functional brain imaging was used to evaluate the intracellular effects of lenrispodun, a new medication that prolongs signaling in dopaminergic brain regions. The study identified a dose that increased brain activity during cognitive response inhibition relative to placebo, providing an example of how neuroimaging can improve the identification of novel medicines for psychiatric disorders.
- 2** An adrenaline-like challenge during functional brain imaging revealed that abnormal heart-brain communication contributes to increased fear in women with generalized anxiety disorder. This was the first brain imaging study to examine how the direct modulation of interoceptive signals influences fear-related (i.e., ventromedial prefrontal cortex) neurocircuitry in individuals with increased anxiety and provides a new neural target for future therapeutic neuromodulation studies.
- 3** Using wireless waterproof monitoring we observed changes in heart rate variability and blood pressure during floatation-REST (Reduced Environmental Stimulation Therapy) in anxious and healthy individuals, providing further evidence that this intervention lowers sympathetic arousal and alters the balance of autonomic nervous system functioning toward a parasympathetic state.

### Current Research Focus

The beating heart sends one of the most important signals to the brain, and the regulation between these organs is central for health and disease. Dr. Khalsa's research uses an experimental medicine framework and pharmacological modulation of the heartbeat to examine the underlying sensory and regulatory brain circuits using brain imaging, electroencephalography, and computational modeling. They hypothesize that a dysregulated heart-brain relationship contributes to the onset and maintenance of several mental health conditions—e.g., mood, anxiety, and eating disorders. By identifying how the brain and heart are dysregulated, this research will provide the biological basis for new treatments aimed at re-establishing balanced regulation between these organs. Dr. Khalsa has also begun to examine gut-brain relationships from a similar perspective, with a focus on eating disorders. His central goals are to discover modifiable neuroscience-based treatment targets for psychiatric disorders, to develop tests to precisely identify these treatment targets in individual patients, and to design neuroscience-based therapies capable of ameliorating the symptoms and signs of mental illness.

### Select Publications

1. *Khalsa SS, Berner L, Anderson LM. Gastrointestinal interoception in eating disorders: charting a new path. Current Psychiatry Reports. 2022 24(1):47-60.*
2. *Teed AR, Feinstein JS, Puhl M, Lapidus RC, Upshaw V, Kuplicki RT, Bodurka J, Ajijola OA, Kaye WH, Thompson WK, Paulus MP, Khalsa SS. Association of Generalized Anxiety Disorder With Autonomic Hypersensitivity and Blunted Ventromedial Prefrontal Cortex Activity During Peripheral Adrenergic Stimulation: A Randomized Clinical Trial. JAMA Psychiatry. 2022 79(4):323-332.*
3. *Khalsa SS, Victor TA, Kuplicki R, Yeh HW, Vanover KE, Paulus MP, Davis RE. Single doses of a highly selective inhibitor of phosphodiesterase 1 (lenrispodun) in healthy volunteers: a randomized pharmacofMRI clinical trial. Neuropsychopharmacology. 2022 47(10):1844-1853.*
4. *Flux MC, Fine TH, Poplin T, Al Zoubi O, Schoenhals WA, Schettler J, Refai H, Naegele J, Wohlrab C, Yeh H, Lowry CA, Levine JC, Smith R, Khalsa SS, Feinstein JS. Exploring the acute cardiovascular effects of Floatation-REST. Frontiers in Neuroscience. 2022 <https://doi.org/10.3389/fnins.2022.995594>*
5. *Walton E, Bernardoni F, Batury VL, Bahnsen K, Larivière S, Abbate-Daga G...Khalsa SS, et.al. Brain Structure in Acutely Underweight and Partially Weight-Restored Individuals With Anorexia Nervosa: A Coordinated Analysis by the ENIGMA Eating Disorders Working Group. Biological Psychiatry. 2022 92(9):730-738.*



### LAB MEMBERS

**EMILY ADAMIC, M.S.**  
Graduate Student, Tulsa University

**EMILY CHOQUETTE, PH.D.**  
Postdoctoral Research Associate

**MCKENNA GARLAND, B.S.**  
Graduate Student, Tulsa University

**ALEXA MORTON, B.S.**  
Research Assistant

**CHARLES VERDONK, M.D., PH.D.**  
Postdoctoral Research Associate

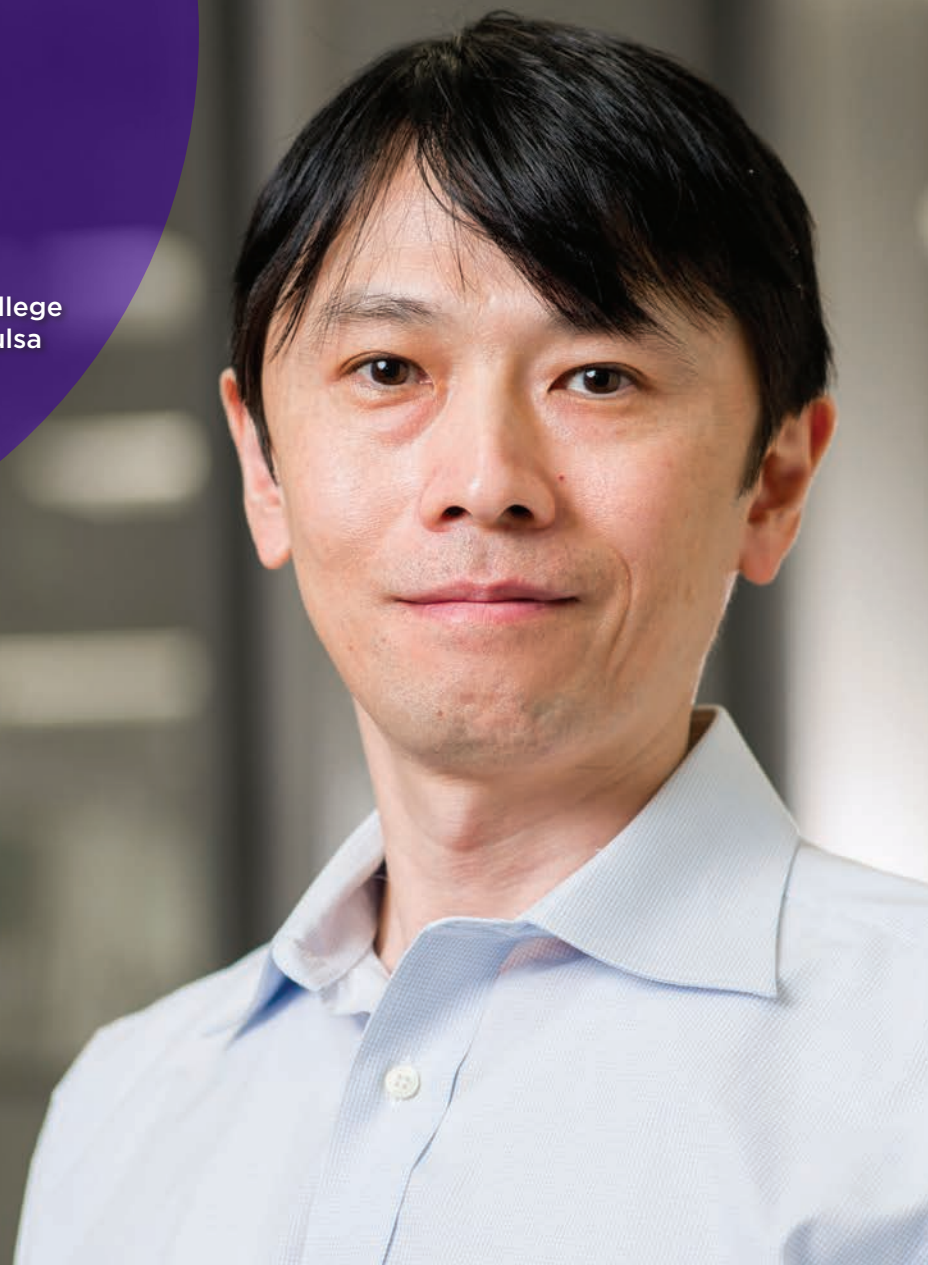
**GREGORY MORRISSEY, M.D.**  
Research Assistant, LIBR Float Clinic  
and Research Center



## MASAYA MISAKI, PH.D.

Associate Investigator,  
Laureate Institute for Brain Research

Research Assistant Professor, Oxley College  
of Health Sciences, The University of Tulsa



## Research Highlights

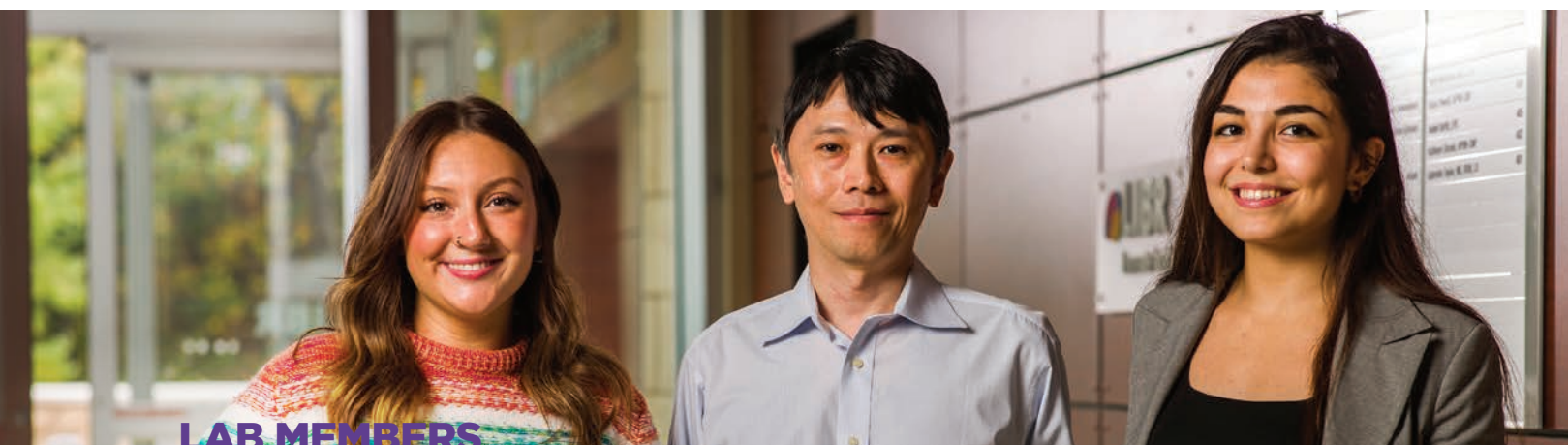
- 1 The open-source package of the advanced real-time processing system for fMRI (RTPSpy) has been released and shared on GitHub (<https://github.com/mamisaki/RTPSpy>).
- 2 Demonstration of proof-of-concept of online closed-loop optimization of the transcranial electric stimulation (tES) parameters with simultaneous real-time fMRI.
- 3 Automated quantitative MRI processing for proton spin parameters of T1, T2, and proton density was implemented within the LIBR MRI system.

### Current Research Focus

Dr. Misaki is an Associate Investigator. His research aims to develop a novel psychiatric treatment utilizing real-time neuroimaging technology with functional magnetic resonance imaging (fMRI) and electroencephalography (EEG). His research employs neurofeedback training where the brain activation signals are measured and presented for patients in real-time to self-regulate their brain activation and mental state.

### Select Publications

1. **Misaki, M.,** Bodurka, J., Paulus, M.P., 2022. A Library for fMRI Real-Time Processing Systems in Python (RTPSpy) With Comprehensive Online Noise Reduction, Fast and Accurate Anatomical Image Processing, and Online Processing Simulation. *Front Neurosci* 16, 834827.
2. Mulyana, B., Tsuchiyagaito, A., **Misaki, M.,** Kuplicki, R., Smith, J., Soleimani, G., Rashedi, A., Shereen, D., Bergman, T.O., Cheng, S., Paulus, M.P., Bodurka, J., Ekhtiari, H., 2022. Online closed-loop real-time tES-fMRI for brain modulation: A technical report. *Brain Behav* 12, e2667.
3. Tsuchiyagaito, A., Sánchez, S.M., **Misaki, M.,** Kuplicki, R., Park, H., Paulus, M.P., Guinjoan, S.M., 2022. Intensity of repetitive negative thinking in depression is associated with greater functional connectivity between semantic processing and emotion regulation areas. *Psychol Med*, 1-12.
4. Kirlic, N., Cohen, Z.P., Tsuchiyagaito, A., **Misaki, M.,** McDermott, T.J., Aupperle, R.L., Stewart, J.L., Singh, M.K., Paulus, M.P., Bodurka, J., 2022. Self-regulation of the posterior cingulate cortex with real-time fMRI neurofeedback augmented mindfulness training in healthy adolescents: A nonrandomized feasibility study. *Cogn Affect Behav Neurosci*.
5. Kerr, K.L., Ratliff, E.L., Cohen, Z.P., Fuller, S., Cosgrove, K.T., DeVille, D.C., **Misaki, M.,** Morris, A.S., Bodurka, J., 2022. Real-Time Functional Magnetic Resonance Imaging Dyadic Neurofeedback for Emotion Regulation: A Proof-of-Concept Study. *Front Hum Neurosci* 16, 910951.



### LAB MEMBERS

**GABE COCHRAN**  
Research Assistant

**CEYDA ELCIN KAYA**  
Research Assistant



## MARTIN PAULUS, M.D.

Scientific Director and President,  
Laureate Institute for Brain Research

Professor, Oxley College of Health Sciences,  
The University of Tulsa



## Research Highlights

- 1 Individuals with depression who have high levels of repetitive negative thinking have difficulty processing negative information, which may be the reason why these individuals have a hard time getting negative thinking “out of their mind”.
- 2 A single dose of ibuprofen changes brain derived micro-RNAs, which regulate the expressions of proteins and other molecules in the brain. This finding may provide a tool to help us to understand what molecular processes go awry in individuals with mental health problems.
- 3 Transcranial direct current stimulation was not able to reduce cravings in methamphetamine-using individuals. There was evidence of changing the functional connectivity between different brain areas in these individuals.

### Current Research Focus

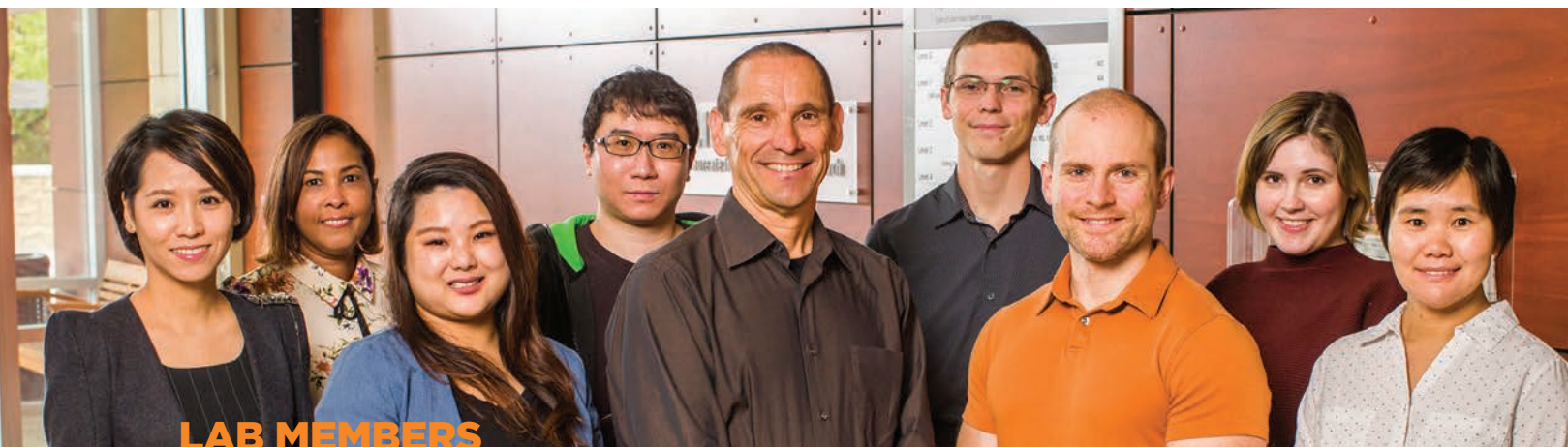
#### Dr. Paulus’ research focuses on three main areas:

My research focuses on the identification of disease-modifying processes (DMP) based on circuits, behavior, or other levels of analysis, which — when modulated — change (1) the risk for, (2) the severity of, or (3) the recurrence of a disease such as mood, anxiety, or substance use disorder. Specifically, we aim to delineate DMPs and provide pathways toward the development of process-specific transdiagnostic interventions that have pragmatic utility, i.e. improve a patient’s condition faster with fewer side effects and fewer recurrences, and explanatory value, i.e., refine our understanding of the causal relationships between specific processes and a mental health condition.

Dr. Paulus has a Google Scholar h-index of 110 and has published over 450 peer-reviewed publications (some in top tier journals like Science, Nature Reviews Neuroscience, PNAS, JAMA Psychiatry, Lancet Psychiatry, Biological Psychiatry, Neuropsychopharmacology, and the American Journal of Psychiatry). Dr. Paulus is the Deputy Editor of JAMA Psychiatry, a Series Editor for Current Topics in Behavioral Neuroscience, and is on several editorial boards of top-tier psychiatric journals. He has served on numerous NIH and International Study Sections and is currently on the National Institute of Mental Health Board of Scientific Councilors. Dr. Paulus is also on the Board of Directors of Anxiety and Depression Association of America, ADAA.

### Select Publications

1. Ekhtiari H, Soleimani G, Kuplicki R, Yeh HW, Cha YH, Paulus M. Transcranial direct current stimulation to modulate fMRI drug cue reactivity in methamphetamine users: A randomized clinical trial. *Hum Brain Mapp.* Aug 1 2022;doi:10.1002/hbm.26007
2. Park H, Kirlic N, Kuplicki R, Tulsa 1000 Investigators, Paulus M, Guinjoan S. Neural Processing Dysfunctions During Fear Learning but Not Reward-Related Processing Characterize Depressed Individuals With High Levels of Repetitive Negative Thinking. *Biological psychiatry : cognitive neuroscience and neuroimaging.* Jul 2022;7(7):716-724. doi:10.1016/j.bpsc.2022.01.002 PMID: PMC9271540
3. Burrows K, Figueroa-Hall LK, Kuplicki R, Stewart JL, Alarbi AM, Ramesh R, Savitz JB, Teague TK, Risbrough VB, Paulus MP. Neuronally-enriched exosomal microRNA-27b mediates acute effects of ibuprofen on reward-related brain activity in healthy adults: a randomized, placebo-controlled, double-blind trial. *Scientific reports.* Jan 17 2022;12(1):861. doi:10.1038/s41598-022-04875-y PMID: PMC8764091



### LAB MEMBERS

**KAIPING BURROWS, PH.D.**  
Staff Scientist

**KATIE FORTHMAN**  
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**HYEJIN SHIM, PH.D.**  
Post-Doctoral Research Fellow

**RAYUS KUPICKI, PH.D.**  
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**AARDRON ROBINSON**  
Research Assistant

**TERESA VICTOR, PH.D.**  
Staff Scientist



## MICHAEL L. ROHAN, PH.D.

Chief Technology Officer,  
MRI Facility Director,  
Laureate Institute for Brain Research



## Research Highlights

Dr. Rohan recently joined the Laureate Institute for Brain Research from McLean Hospital in Boston, MA, where he was the Director of High Field Magnetic Resonance (MR) Systems.

- 1** Dr. Rohan plans to initiate an investigation of image acquisition and processing methods for functional MRI. Imaging research at LIBR relies on robust data acquisition. This project will evaluate new developments in magnetic resonance imaging (MRI) technology for inclusion in the research protocols at LIBR.
- 2** Dr. Rohan plans to study the mechanisms of Low Field Magnetic Stimulation, a novel electromagnetic therapy for bipolar depression. This first investigation will be an imaging study of the immediate effects of this treatment.
- 3** Data from the Tulsa 1000 study, as well as the COBRE NeuroMap study, contain the results of a unique tissue characterizing scan, acquired as an exploratory acquisition, that may contain clues to neuroinflammation. Dr. Rohan plans to perform an analysis of this data in collaboration with Dr. Savitz (LIBR) in a search for biomarkers of inflammation.

### Current Research Focus

Dr. Rohan's main research effort is to ensure that the most recent and robust MRI data acquisition methods are available to the LIBR community. New acquisition methods will be possible with the arrival of new MRI system hardware in 2023 and the new coils and electronics will support higher resolution and faster scanning, which will be evaluated against existing methods. Image processing methods have also advanced recently and will be evaluated against existing methods using the strength of cognitive imaging results as criteria.

Dr. Rohan's main focus for 2023 will be the purchase and installation of LIBR's first new MRI system in 10 years, as its oldest MRI system is replaced. The increase in signal-to-noise, scan coverage and scan rate made possible by the new system will enable more robust imaging results for the LIBR research community. Dr. Rohan directs the MRI Facility at the Laureate Institute and is working with the facility staff on streamlining scan scheduling and records to better accommodate new research projects expected in 2023.

Dr. Rohan has developed a novel electromagnetic treatment for bipolar depression, Low Field Magnetic Stimulation (LFMS). LFMS has undergone clinical pilot studies over the last several years. At LIBR in 2023, Dr. Rohan will investigate the immediate effects on the brain of this treatment using a compact imaging protocol with the goal of identifying a fast method of estimating effect size.

### Career papers and patents of interest

- 1. Michael L Rohan, Steven B Lowen, Anna Rock, Susan L Andersen.** Novelty preferences and cocaine-associated cues influence regions associated with the salience network in juvenile female rats *Pharmacol Biochem Behav.* 2021 Apr;203:173117.
- 2. Anderson CM, Kaufman MJ, Lowen SB, Rohan M, Renshaw PF, Teicher MH.** Brain T2 relaxation times correlate with regional cerebral blood volume. *MAGMA.* 2005;18(1):3-6.
- 3. Rohan M, Parow A, Stoll AL, Demopoulos C, Friedman S, Dager S, Hennen J, Cohen BM, Renshaw PF.** Low-field magnetic stimulation in bipolar depression using an MRI-based stimulator. *Am J Psychiatry.* 2004;161(1):93-98.
- 4. Rohan ML, Evans R;** Advanced NMR Systems, Inc. Gradient Coil Power Supply and Imaging Method. US 5,521,507. 1996 May 28.
- 5. Rohan ML, Rzedzian RR.** Stimulation by time-varying magnetic fields. *Ann N Y Acad Sci.* 1992;649:118-128.



### MRI FACILITY STAFF

**JULIE ARTERBURY**  
Senior MRI Technologist

**LESLIE WALKER**  
MRI Technologist

**AMY GINN**  
MRI Technologist

**MASAYA MISAKI**  
Associate Investigator



## JONATHAN SAVITZ, PH.D.

Principal Investigator,  
Laureate Institute for Brain Research

Associate Professor,  
Oxley College of Health Sciences,  
The University of Tulsa

Volunteer Faculty Member,  
Department of Psychiatry,  
The University of Oklahoma



## Research Highlights

- 1 Dr. Savitz co-edited a book with Dr. Robert Yolken, Johns Hopkins University School of Medicine, entitled *Microorganisms and Mental Health*, which includes chapters by experts in the field covering the role played by a variety of microorganisms in mental illness.
- 2 The lab has continued our work on the kynurenine pathway, showing that ibuprofen increases the serum concentrations of the neuroprotective metabolite, kynurenic acid, and that neurotoxic kynurenine metabolites are associated with white matter abnormalities in individuals with depression.
- 3 Dr. Savitz published a review in *Biological Psychiatry* with Dr. Timothy Meier, Medical College of Wisconsin, on the role of the kynurenine pathway in traumatic brain injury.
- 4 Along with Dr. Bart Ford, Oklahoma State University, Dr. Savitz published a comprehensive review on the effects of depression on COVID-19 morbidity and COVID-19 vaccine immunogenicity.

### Current Research Focus

Depression is one of the most serious and common psychiatric disorders, yet we know very little about the underlying disease process. Our lab is examining whether inflammation of the brain is one cause of depression. In particular, we are using blood-based immune markers, viral antibodies, and experimental medicine designs to examine how inflammatory processes affect the healthy and diseased brain. Ultimately, this research can help to identify new treatments for depression that are based on modifying the inflammatory process.

### Select Publications

1. *Microorganisms and Mental Health*. J. Savitz and R.H. Yolken (Eds). (2022). Springer-Nature. In Press.
2. Meier, T.B., Savitz, J. (2022). The kynurenine pathway in traumatic brain injury: Implications for psychiatric outcomes. *Biological Psychiatry*. 91, 449-458.
3. Ford, B.N. and Savitz, J. (2022). Depression, Aging, and Immunity: Implications for COVID-19 Vaccine Immunogenicity. *Immunity and Ageing*. 19, 32.
4. Zheng, H., Teague, T.K., Yeh, F.C., Burrows, K., Figueroa-Hall, L.K., Aupperle, R.L., Khalsa, S.S., Paulus, M.P., Savitz, J. (2022). C-Reactive Protein and the Kynurenic Acid to Quinolinic Acid Ratio are Independently Associated with White Matter Integrity in Major Depressive Disorder. *Brain, Behavior, and Immunity*. 105, 180-189.
5. Savitz, J., Ford, B.N., Kuplicki, R. Khalsa, S., Teague, T.K., Paulus, M.P. (2022). Acute Administration of Ibuprofen Increases Serum Concentration of the Neuroprotective Kynurenine Pathway Metabolite, Kynurenic Acid: a pilot randomized, placebo-controlled, cross-over study. *Psychopharmacology*. 239, 3919-3927.



### LAB MEMBERS

SOUMYA MUNSHI, PH.D.  
Post-Doctoral Research Associate

MACGREGOR THOMAS  
Research Specialist



## RYAN SMITH, PH.D.

Principal Investigator,  
Laureate Institute for Brain Research  
Research Associate Professor,  
Oxley College of Health Sciences,  
The University of Tulsa



## Research Highlights

- 1** Dr. Smith had 12 research articles and one book chapter published in 2022, with one additional article currently in press. He also published three popular articles explaining new research results for public audiences. Dr. Smith gave 12 invited international talks and three additional national talks presenting his research in 2022, including the annual meeting of the Anxiety & Depression Association of America, the Zurich Computational Psychiatry Course, the annual Organization for Computational Neuroscience meeting, a symposium at Kyushu University (Japan), a symposium at University College London, and a meeting at Princeton University, among others.
- 2** Dr. Smith received a large three-year grant from the Well-being for Planet Earth Foundation to study neurocomputational predictors of subjective well-being. He is also currently running studies examining interoception and effects of anxiety induction on computational mechanisms of decision-making in patients with anxiety, depression, and/or methamphetamine use disorders. He also recently submitted an R01 grant application to the National Institute on Drug Abuse (NIDA) to extend his work on individuals with substance use problems. He was also invited to join the editorial board (Associate Editor) for Autonomic Neuroscience, a specialty section of Frontiers in Neurology, Neuroscience and Physiology.
- 3** Dr. Smith welcomed four very bright and talented researchers to his lab this year, including one research assistant (Claire Lavalley), two graduate students (Marishka Mehta and Rowan Hodson), and one post-doctoral research fellow (Navid Hakimi).



### LAB MEMBERS

**ANNIE CHUNING**  
Research Assistant  
**CLAIRE LAVALLEY**  
Research Assistant  
**ROWAN HODSON**  
Graduate Student

**MARISHKA MEHTA**  
Graduate Student  
**NAVID HAKIMI, PH.D.**  
Post-Doctoral Research Associate

### Current Research Focus

Dr. Smith's lab focuses on understanding the neurocomputational mechanisms underlying emotion-cognition interactions and how they relate to brain-body interactions, with a special focus on information-seeking behavior, prospective planning, and interoception. Lab projects also focus on how these mechanisms are affected in depression, anxiety, and substance use disorders. The primary research methods used in the lab are neuroimaging and computational modeling, including a wide range of modeling approaches (e.g., drift-diffusion models, reinforcement learning models, active inference models). A major overarching focus is to characterize information processing differences between mentally healthy and unhealthy individuals with the goal of improving diagnosis and treatment selection within psychiatry and clinical psychology.

### Select Publications

- 1. Smith R, Steklis HD, Steklis N, Weihs K, Allen JJB, Lane RD.** Lower emotional awareness is associated with greater early adversity and faster life history strategy. *Evolutionary Behavioral Sciences.* 2022:ebs0000282.
- 2. Smith R, Friston KJ, Whyte CJ.** A step-by-step tutorial on active inference and its application to empirical data. *Journal of Mathematical Psychology.* 2022;107:102632.
- 3. Smith R, Taylor S, Wilson RC, Chuning AE, Persich MR, Wang S, et al.** Lower Levels of Directed Exploration and Reflective Thinking Are Associated With Greater Anxiety and Depression. *Frontiers in Psychiatry.* 2022;12.
- 4. Smith R, Taylor S, Stewart JL, Guinjoan SM, Ironside M, Kirlic N, et al.** Slower Learning Rates from Negative Outcomes in Substance Use Disorder over a 1-Year Period and Their Potential Predictive Utility. *Computational Psychiatry.* 2022;6(1):117-41.
- 5. Smith R, Varshney L-R, Nagayama S, Kazama M, Kitagawa T, Managi S, et al.** A computational neuroscience perspective on subjective wellbeing within the active inference framework. *International Journal of Wellbeing.* 2022:In Press.



## JENNIFER L. STEWART, PH.D.

Principal Investigator,  
Associate Director for Training and Mentoring  
Laureate Institute for Brain Research

Associate Professor, Oxley College  
of Health Sciences, The University of Tulsa



## Research Highlights

- 1 Dr. Stewart's collaboration with Drs. Kaiping Burrows and Sahib Khalsa demonstrated that depressed individuals show blunted insula, amygdala, and striatum responses when paying attention to their own internal bodily signals, whether or not they are taking selective serotonin reuptake inhibitors (SSRIs), suggesting that this type of medication does not correct impaired interoceptive attention in depression.
- 2 Dr. Stewart's research assistants presented posters at LIBR's first annual Research Day in October 2022, showing that: (1) individuals with pure and comorbid depression (with generalized anxiety) report greater eating/appetite dysfunction than healthy individuals, despite no differences in leptin/adiponectin blood concentrations; (2) heightened anhedonia (loss of interest/pleasure) and negative urgency (taking rash action when in a bad mood) predict relapse in a modest sample of opioid users; (3) although heightened personal trauma history and family history of problem substance use characterize opioid users, these factors do not appear to predict future relapse; and (4) opioid users with and without a history of suicidal ideation/behavior did not appear to differ on physical pain or psychological distress tolerance.
- 3 Dr. Stewart collaborated with Dr. Sahib Khalsa on a pilot study testing feasibility of Floatation-REST (Reduced Environmental Stimulation Therapy) in individuals receiving treatment for methamphetamine use disorder. In this study, individuals (N=32) completed two within-subject, counterbalanced sessions: one in a float pool (Pool-REST), and the other in an active comparator condition (Chair-REST, aiming to control for the effects of simple relaxation while participants lay supine in a zero-gravity chair situated in a quiet, dimly lit room). Results indicate that whereas both conditions reduced negative affect and state anxiety, only the Pool significantly reduced stimulant drug craving, increased positive affect, improved attentiveness, and lessened fatigue; these findings show promise for Pool-REST as a potential add-on intervention to reduce stress and craving in methamphetamine users.



### LAB MEMBERS

**CHRYSANTHA DAVIS**  
Research Assistant

**ABIGAIL PLEIMAN**  
Research Assistant

**BREANNA MCNAUGHTON**  
Research Assistant

**MEGAN POSEY**  
Research Assistant

**RICARDO WILHELM, PH.D.**  
Post-Doctoral Research Associate

**NATOSHA MARKHAM**  
Clinical Research Interviewer

### Current Research Focus

Dr. Stewart earned tenure and was promoted to Associate Professor at The University of Tulsa in 2022. Dr. Stewart uses electroencephalography (EEG) and functional magnetic resonance imaging (fMRI) methods to identify brain alterations in cognitive and emotional processing in individuals struggling with symptoms of major depressive disorder and substance use disorders (methamphetamine and opioids). She is working on testing whether these brain alterations can predict future treatment completion/response as well as success in reducing substance use.

### Select Publications

1. Burrows, K., DeVille, D., Cosgrove, K., Kuplicki, R., Tulsa 1000 Investigators, Paulus, M. P., Aupperle, R. L., Khalsa, S. K., & Stewart, J. L. (2022). Impact of serotonergic medication on interoception in major depressive disorder. *Biological Psychology*, 108286. doi: 10.1016/j.biopsycho.2022.108286.
2. May, A. C., Davis, C., Kirlic, N., & Stewart, J. L. (2022). Mindfulness-based interventions for the treatment of aberrant interoceptive processing in substance use disorders. *Brain Sciences*, 12, 279. <https://doi.org/10.3390/brainsci12020279>
3. Smith, R., Taylor, S., Stewart, J. L., Guinjoan, S. M., Ironside, M., Kirlic, N., ... & Tulsa 1000 Investigators. (2022). Slower learning rates from negative outcomes in substance use disorder over a 1-year period and their potential predictive utility. *Computational Psychiatry*, 6, 117-141. <http://doi.org/10.5334/cpsy.85>
4. White, E. J., Demuth, M. J., Nacke, M., Kirlic, N., Kuplicki, R., Spechler, P. A., McDermott, T. J., DeVille, D. C., T1000 Investigators, Stewart, J. L., Lowe, J., Paulus, M. P., & Aupperle, R. L. Neural processes of inhibitory control in American Indian peoples are associated with reduced mental health problems. *Social Cognitive and Affective Neuroscience*. <https://doi.org/10.1093/scan/nsac045>
5. Yu, X., Cohen, Z. P., Tsuchiyagaito, A., Cochran, G., Aupperle, R. L., Stewart, J. L., ... & Kirlic, N. (2022). Neurofeedback-augmented mindfulness training elicits distinct responses in the subregions of the insular cortex in healthy adolescents. *Brain Sciences*, 12, 363. <https://doi.org/10.3390/brainsci12030363>



## WESLEY THOMPSON, PH.D.

Principal Investigator,  
Laureate Institute for Brain Research

Research Associate Professor,  
Oxley College of Health Sciences,  
The University of Tulsa

Adjunct Professor,  
The University of California, San Diego



## Research Highlights

- 1** We developed a novel multivariate Sparse Functional Principal Components (mSFPCA) algorithm, which characterizes trajectories as a smooth mean plus a weighted combination of the smooth major modes of variation about the mean, where the weights are given by the component scores for each subject. Unlike existing methods, the mSFPCA algorithm allows estimation of multiple trajectories simultaneously, such as the component scores. Although we focused on application of mSFPCA to microbiome data, the mSFPCA model is of general utility and can be used in a wide range of real-world applications.
- 2** Reproducible brain-wide association studies require thousands of individuals. Mental health research and care have yet to realize significant clinical advances from MRI. A primary challenge has been replicating associations between inter-individual differences in brain structure or function and complex cognitive or mental health phenotypes (brain-wide association studies (BWAS)). We used three of the largest neuroimaging datasets currently available—with a total sample size of around 50,000 individuals—to quantify BWAS effect sizes and reproducibility as a function of sample size; BWAS associations were smaller than previously thought, resulting in statistically underpowered studies, inflated effect sizes, and replication failures at typical sample sizes.
- 3** Semi-continuous data present challenges in both model fitting and interpretation: parametric distributions may be inappropriate for extreme long right tails of the data; mean effects of covariates, heavily influenced by extreme values, may fail to capture relevant associations for most of the sample. We proposed a two-component semi-parametric Bayesian mixture model, with the discrete component captured by a probability mass (typically at zero) and the continuous component of the density modeled by a mixture of B-spline densities.
- 4** The lab's publications have continued to appear in top-ranked journals in their respective fields, including Science, PNAS, Nature Neuroscience, JAMA Psychiatry, Cerebral Cortex, Annals of Applied Statistics, Nature Communications, Molecular Psychiatry, Biological Psychiatry, and NeuroImage, among others. In addition, Dr. Thompson's work has led to many invited talks, workshops, and symposia, both nationally and internationally.

### Select Publications

1. Marek S, et al. Reproducible brain-wide association studies require thousands of individuals. *Nature*. 2022 Mar;603(7902):654-660.
2. Davies M, Horsdal HT, Antonsen S, Sigsgaard T, Fan CC, Thompson WK, Pedersen CB, Sabel CE. The complexities of suicide: a multilevel survival analysis examining individual, familial and neighbourhood determinants of suicide risk using Danish register-based data. *Psychol Med*. 2022 Dec 14:1-10.
3. Wang SH, Wu CS, Hsu LY, Lin MC, Chen PC, Thompson WK, Fan CC. Paternal age and 13 psychiatric disorders in the offspring: a population-based cohort study of 7 million children in Taiwan. *Mol Psychiatry*. 2022 Dec;27(12):5244-5254.
4. Kuplicki RT, Thompson WK. Characterizing and Coding Psychiatric Diagnoses Using Electronic Health Record Data. *JAMA Psychiatry*. 2022 Sep 14.

## LAB MEMBERS

JUNTING REN  
Graduate student

HOWON RYU  
Graduate student

FIRAS NABER  
Data Scientist

WENJIE ZHANG  
Data Scientist

LUCY SHAO  
Graduate student

CHENYU LIU  
Graduate student

## Current Research Focus

Dr. Thompson's research focuses on the development and application of statistical models to population genetic and neurodevelopmental studies. To foster this research agenda, in 2020 I formed the Population Neuroscience and Genetics (PoNG) Lab (<https://chd.ucsd.edu/research/PoNG/index.html>) with my then Department of Radiology colleague Dr. Chun Fan, focused on developing novel statistical methods for imaging genetics with applications to large population-based studies. Despite its recent inception, the PoNG Lab already has numerous local, national, and international collaborators, and they currently continue to fund several graduate and post-doctoral scholars. This research has already resulted in several peer-reviewed publications and manuscripts in progress.

In the past year, Dr. Thompson has collaborated as a Co-Investigator on several new NIH grant application submissions. As a result, he is the principal investigator (PI) of two new ROIs and serves as the subcontract PI on several studies, including contracts and subcontracts from Stanford Research International, UCLA, USC, Children's Hospital Los Angeles (CHLA), and the Institute for Biological Psychiatry (Denmark).

### Neurodevelopmental Studies

Dr. Thompson has an active research program developing and applying novel statistical models for neurodevelopmental data, most recently for longitudinal brain imaging across the lifespan, both to determine trajectories of normative development and to determine causes and consequences of abnormal brain development. His statistical applications generally involve Magnetic Resonance Imaging (MRI), a flexible imaging modality from which different types of images can be generated to emphasize contrast related to different tissue characteristics.

### Methods with Application to Human Genetics

Dr. Thompson also has a very active research program in developing and applying novel statistical methods to human genetics data, especially methods for increasing power for discovery and for improved estimation of heritability.

### Open Science and Best Statistical Practices

A major focus of the ABCD Study and the PoNG Lab is promoting open science and best statistical practices in the neuroimaging community. To promote these efforts, we have developed the ABCD Data Exploration and Analysis Portal (DEAP). Dr. Thompson and PoNG Center co-director, Dr. Fan, have obtained NIH funding to extend DEAP to incorporate harmonization of imaging genetic analyses across multiple studies.



## AKI TSUCHIYAGAITO, PH.D.

Associate Investigator,  
Laureate Institute for Brain Research  
Research Assistant Professor, Oxley College  
of Health Sciences, The University of Tulsa



## Research Highlights

- 1** Dr. Tsuchiyagaito's lab collaborated with Dr. Misaki's lab on a feasibility and pilot study of "Connectivity-based real-time fMRI neurofeedback modulating default-mode network to reduce repetitive negative thinking in depression." Drs. Tsuchiyagaito and Misaki reported that real-time fMRI neurofeedback successfully reduced repetitive negative thinking in their recent publication.
- 2** In collaboration with Dr. Guinjoan's lab, Dr. Tsuchiyagaito conducted a propensity matched study with major depressive disorder (MDD) in the CoBRE Core dataset, and compared the brain's functional connectivity during resting-state fMRI between individuals with high and low levels of repetitive negative thinking. They discovered that MDD-affected individuals with higher levels of repetitive negative thinking, relative to those with lower levels of repetitive negative thinking, have greater connectivity between anterior insula (plays an important role in emotion regulation and interoceptive awareness) and superior temporal sulcus (speech related area).
- 3** Drs. Tsuchiyagaito, Misaki, Guinjoan, and Paulus started a new LIBR project to decode the brain status associated with rumination, worry, and positive thoughts and to monitor how individuals can disengage from rumination and worry through mindfulness and cognitive reappraisal. Her study coordinator, Gabe Cochran, who is also interested in pursuing a doctorate in Clinical Psychology, has been successfully recruiting and conducting this research project.

### Current Research Focus

About 1 in 10 young adults suffer from major depressive disorder (MDD), which is among the most common mental health conditions in young adulthood, and can interfere with the successful transition into middle adulthood, if not effectively treated. Repetitive negative thinking, a cognitive process that encompasses future- (worry) and past- (rumination) directed thoughts, is associated with both poor prognosis and treatment resistance. Novel treatments designed to modify the neurobiological mechanisms underlying repetitive negative thinking could facilitate recovery in MDD. Dr. Tsuchiyagaito's lab focuses on promoting mental health in young adults and adolescents by understanding the brain mechanisms underlying repetitive negative thinking and developing interventions to enhance the ability to disengage from repetitive negative thinking.

### Select Publications

- 1** Tsuchiyagaito A\*, Misaki M\*, Kirlic N, Yu X, Sánchez SM, Cochran G, Stewart JL, Smith R, Fitzgerald KD, Rohan ML, Paulus MP, Guinjoan SM. (in press). Real-time fMRI functional connectivity neurofeedback reducing repetitive negative thinking in depression: a double-blind, randomized, sham-controlled proof-of-concept trial. *Psychother Psychosom*. \*Contributed equally.
- 2** Tsuchiyagaito A, Sánchez SM, Misaki M, Kuplicki R, Park H, Paulus MP, Guinjoan S M. Intensity of repetitive negative thinking in depression is associated with greater functional connectivity between semantic processing and emotion regulation areas. *Psychol Med*. 2022 Aug 31;:1-12.
- 3** Park H, Sánchez SM, Kuplicki R, Tsuchiyagaito A, Khalsa SS, Paulus MP, Guinjoan SM. Attenuated interoceptive processing in individuals with major depressive disorder and high repetitive negative thinking. *J Psychiatr Res*. 2022 Oct 10;156:237-244.
- 4** Kirlic N, Cohen ZP, Tsuchiyagaito A, Misaki M, McDermott TJ, Aupperle RL, Stewart JL, Singh MK, Paulus MP, Bodurka J. Self-regulation of the posterior cingulate cortex with real-time fMRI neurofeedback augmented mindfulness training in healthy adolescents: A nonrandomized feasibility study. *Cogn Affect Behav Neurosci*. 2022 Aug;22(4):849-867.
- 5** Yu X, Cohen ZP, Tsuchiyagaito A, Cochran G, Aupperle RL, Stewart JL, Singh MK, Misaki M, Bodurka J, Paulus MP, Kirlic N. Neurofeedback-Augmented Mindfulness Training Elicits Distinct Responses in the Subregions of the Insular Cortex in Healthy Adolescents. *Brain Sci*. 2022 Mar 9;12(3).

### LAB MEMBER

GABE COCHRAN  
Research Assistant





## EVAN WHITE, PH.D.

Principal Investigator,  
Laureate Institute for Brain Research  
Director of Electroencephalography Core,  
Laureate Institute for Brain Research  
Director of Native American Research,  
Laureate Institute for Brain Research  
Research Associate Professor, Oxley College  
of Health Sciences, The University of Tulsa  
Director of Native American Research,  
Affiliated Faculty, Oklahoma State  
University, Center of Indigenous  
Health Research and Policy



## Research Highlights

- 1** Dr. White submitted a Director's Pioneer Award Program (DPI) grant proposal in collaboration with the Shawnee Tribe of Oklahoma titled: Kipiyeecipsakiciipe "Coming Home": Establishing Clinical Cultural Neuroscience As A Tool For Understanding The Role Of Traditional Cultural Engagement In Mitigating Substance Misuse And Disorder. Within American Indian (AI) populations, there is a disproportionate share of negative health and social consequences of substance use disorder (SUD) even after decades of awareness and research. Dr. White proposes in this project to integrate community based participatory research (CBPR) with neuroscience tools to examine the influence of traditional cultural engagement on resilience factors that may protect against poor mental health as well as risk for substance use.
- 2** Resilience factors that protect against poor mental health within American Indian (AI) populations have been investigated; however, neural mechanisms of these effects remain under explored. In a recently published study, Dr. White's group examined inhibition using fMRI data and found that inhibitory control processing in some AI individuals may represent a neural mechanism of protective effects against mental health problems in AI.
- 3** Dr. White, in collaboration with partners at Cherokee Nation, published a set of recommendations for using AI participant data from large-scale open access data sets. These recommendations are critically important due to a history of inappropriate research approaches used in work with AI communities and a proliferation of open access data available for analysis. This paper is titled: *Five Recommendations For Using Large-Scale Publicly Available Data To Advance Health Among American Indian Peoples: The Adolescent Brain And Cognitive Development (ABCD) Study<sup>sm</sup> As An Illustrative Case*

### Current Research Focus

Dr. White is a Principal Investigator and Director of Native American Research. His work aims to establish and advance neuroscientific understanding of cultural factors that are protective against poor mental health among American Indians utilizing a strength-based framework. A focus of this research is combining multi-modal neuroscience and psychophysiology with community based participatory research (CBPR) approaches. This approach to research brings community partners to the table in the scientific endeavor to ensure community priorities are represented and that the results of the work make a positive impact in the community. Dr. White's goal is to integrate clinical and cultural neuroscience to identify modifiable factors as candidate treatment targets for mental health intervention and prevention. Dr. White also is the Director of the Electroencephalography (EEG) core, overseeing the facilities EEG technology and data processing infrastructure and ensuring LIBR investigators have support to conduct state-of-the-art research using EEG techniques.

### Select Publications

- 1. White, E.J., Demuth, M.J., Nacke, M., Kirlic, N. Kuplicki, R., Spechler, P.A., McDermott, T.J., DeVille, D.C., T1000 investigators, Stewart, J.L., Lowe, J, Paulus, M.P., & Aupperle, R.L. (2022). Neural processes underlying inhibitory control in American Indian peoples is associated with reduced mental health problems. *Social Cognitive and Affective Neuroscience*. Advanced online publication.**
- 2. White, E.J., Demuth, M.J., Wiglesworth, A., Coser, A.D., Garrett, B.A., Kominsky, T.K., Jernigan, V.B.B., Thompson, W.K., Paulus, M.P., & Aupperle, R.L. (2022). Five recommendations for using large scale publicly available data to advance health among American Indian Peoples: The Adolescent Brain and Cognitive Development (ABCD) Study as an illustrative case. *Neuropsychopharmacology*.**
- 3. Kraft, J. D.\*\*, Grant, D. M., Nagel, K. M., Deros, D. E., Frosio, K. E., Taylor, D. L., & White, E. J. (2022). Independent psychometric evaluation of the Social Anxiety Questionnaire. *Psychiatric Quarterly*, 93(2), 483-498.**
- 4. Kraft, J.D.\*\*, Grant, D.M., Deros, D.E., Nagel, K.M., Taylor, D.L., Frosio, K.E., & White, E.J. (2022). Documenting Neural Mechanisms of Self-imagery within Social Anxiety. *Psychiatry Research: Neuroimaging*, 321, 111457.**
- 5. Ivanich, J., Sarche, M., White, E.J., Marshall, S.M., Russette, H. Ullrich, J.S. & Whitesell, N.R., (2022). Increasing native research leadership through an early career development program. *Frontiers in Public Health*, 10, 770498**



### LAB MEMBERS

**DANIELLE BETHEL**  
Lab Coordinator

**LIZBETH ROJAS**  
DReaM-Neuro Fellow

**RICARDO WILHELM, PH.D.**  
Post-Doctoral Research Associate

**NICOLE BAUGHMAN**  
Undergraduate Research Intern

**ERIC MANN**  
EEG Core Research Assistant



## HAIXIA ZHENG, PH.D.

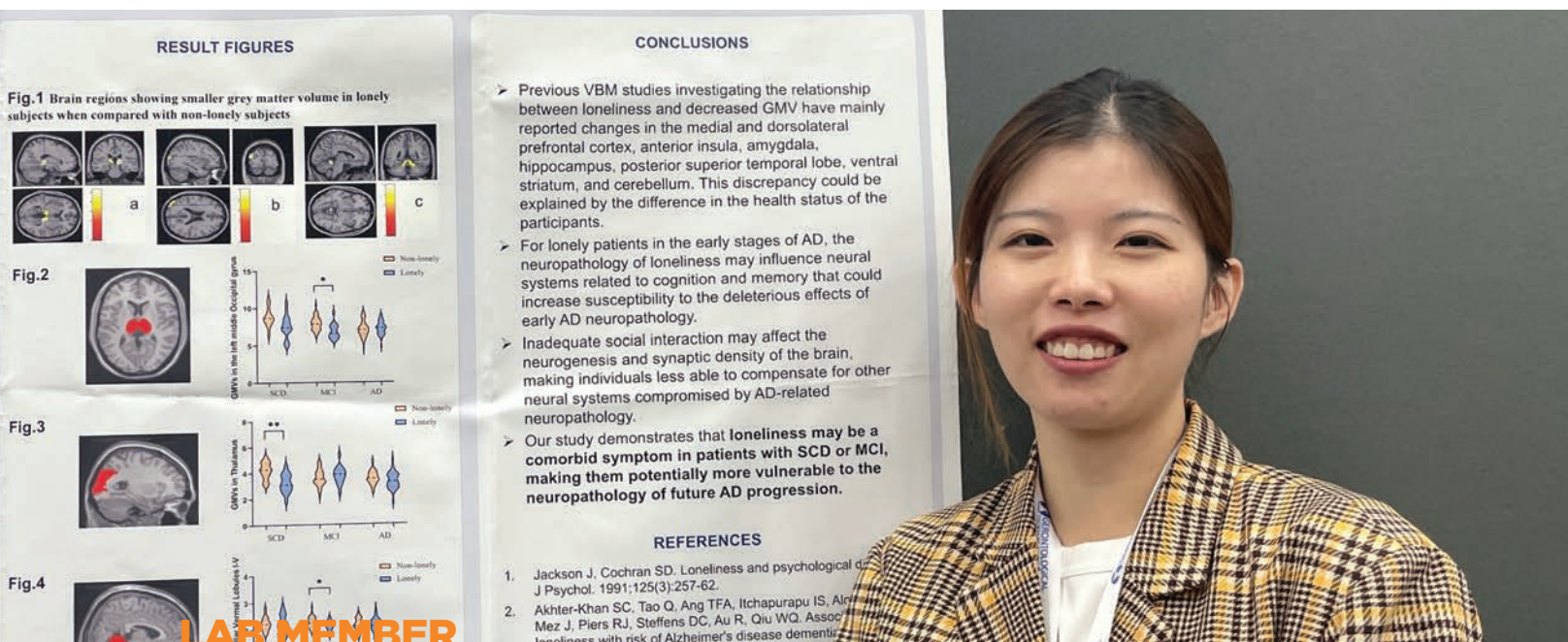
Associate Investigator,  
Laureate Institute for Brain Research

Research Assistant Professor, Oxley College  
of Health Sciences, The University of Tulsa



## Research Highlights

- 1 By applying novel tractography techniques, we began to understand that elevated systemic inflammation is associated with reduced integrity of corticolimbic white matter pathways in depression.
- 2 We observed individuals infected with cytomegalovirus showed a higher likelihood of having neuroinflammation, increased microglia activation, and doubled the risk of committing suicide in postmortem brain samples, suggesting cytomegalovirus infection may be a targetable source of neuroinflammation that contributes to the development of mental illness.
- 3 We are preparing to leverage existing biobank data and statistical causal inference to ascertain evidence for a causal pathway from neurotropic herpes viral infection to brain alterations and psychiatric disorders, which could provide evidence base for the development of intervention/prevention strategy.



## LAB MEMBER

**YE ZHANG**  
Ph.D. student, Tohoku University, Japan  
Research Assistant

## Current Research Focus

Chronic inflammatory process has been shown to affect brain structure and function, which has been hypothesized to contribute to pathogenesis of psychiatric disorders. Dr. Zheng launched her lab at LIBR in 2022 as an associate investigator. Dr. Zheng's research focuses on investigating how immune activity and cytomegalovirus (a neurotropic herpesvirus) affects brain structure and function in the context of psychiatric disorders via combining peripheral immune markers and state-of-the-art neuroimaging techniques. The long-term goal of Dr. Zheng's research is to further delineate the role of neurotropic viruses in the development and maintenance of psychiatric disorders and determine the modifiable targets for interventions to mitigate psychiatric disorders.

## Select Publications

1. **Zheng H, Teague TK, Yeh FC, Burrows K, Figueroa-Hall LK, Aupperle RL, Khalsa SS, Paulus MP, Savitz J.** C-Reactive protein and the kynurenic acid to quinolinic acid ratio are independently associated with white matter integrity in major depressive disorder. *Brain Behav Immun.* 2022 Oct;105:180-189.
2. **Zheng H, Savitz J.** Effect of Cytomegalovirus Infection on the Central Nervous System: Implications for Psychiatric Disorders. *Curr Top Behav Neurosci.* 2022 May 4.
3. **Thomas M, Savitz J, Zhang Y, Burrows K, Smith R, Figueroa-Hall L, Kuplicki R, Khalsa SS, Taki Y, Teague TK, Irwin MR, Yeh FC, Paulus MP, Zheng H, On Behalf Of Tulsa Investigators.** Elevated Systemic Inflammation Is Associated with Reduced Corticolimbic White Matter Integrity in Depression. *Life (Basel).* 2021 Dec 28;12(1):43.
4. **R. Smith, S. Taylor, J. L. Stewart, S. M. Guinjoan, M. Ironside, N. Kirlic, et al.** Slower Learning Rates from Negative Outcomes in Substance Use Disorder over a 1-Year Period and their Potential Predictive Utility. *medRxiv.* 2021; 2021.10.18.21265152



# ONGOING STUDIES



**Affected by depression?**  
We want to help.

**JOIN OUR THERAPY STUDY**  
CALL 918-344-8611

**LIBR**  
Laureate Institute for Brain Research

**ABOUT OUR RESEARCH**  
This study aims to explore how effective Behavioral Activation Depression Therapy is in reducing symptoms of depression. As a participant you will receive 10 weeks of therapy and complete tasks, questionnaires, blood draws, and EEG. To see what's happening in your brain we will use magnetic resonance imaging (MRI), a very safe technology that takes live images of your brain as it's working. Compensation will be provided.

**ABOUT THE THERAPY**  
Depressive symptoms can impact our day-to-day behavior. Feeling down or depressed, and tired all of the time can reduce our desire to seek out and enjoy daily activities. The fewer things we enjoy, the more down or depressed we may feel. Behavioral activation breaks this vicious cycle by providing opportunities and motivation to engage in more pleasurable and rewarding activities. Behavioral activation also helps us tackle those daunting to-do lists by breaking activities down in a manageable and realistic way.

**WE NEED YOU**  
You may be eligible for this study if you are:  
• 18 to 55 years old  
• male OR female  
• depressed  
**SYMPTOMS OF DEPRESSION**  
Loss of pleasure in things you used to enjoy, difficulty sleeping, feeling depressed or blue, changes in weight or appetite, difficulty concentrating, decreased energy or fatigue, moving or talking more slowly.

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Visit us online at [www.laureateinstitute.org](http://www.laureateinstitute.org) or email [neurocatt@libr.net](mailto:neurocatt@libr.net)

**Neuroscientific Exploration of Cultural Protective Factors among American Indians**



Artwork provided by Comanche artist Timothy Tate Nevaquaya

**ABOUT OUR RESEARCH**  
LIBR is recruiting Native American adults for a new research study to better understand cultural factors and resilience.

**HOW TO PARTICIPATE**  
To be eligible, you must be:  
• 21 - 65 years of age  
• American Indian  
• Fluent in English

**Compensation will be provided**

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We use magnetic resonance imaging (MRI) and electroencephalography (EEG) to take live images of the brain and record brain activity in real time. It's safe, painless, and involves no radiation.

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**Improving Mental Health Through Neuroscience**

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**LIBR**  
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**Are You Depressed?**  
Help us understand how the brain functions in individuals with Major Depressive Disorder (MDD)

**ABOUT OUR RESEARCH**  
The Laureate Institute for Brain Research (LIBR) is studying the biological basis of Major Depressive Disorder (MDD). We conduct research using magnetic resonance imaging (MRI) to make images of the brain. These images help researchers understand how the brain processes emotion and motivation. MRI is safe, painless, and involves no radiation.

**WE NEED YOU**  
You are eligible if you are:  
• male or female  
• currently depressed  
• ages 18-55  
• not currently taking psychiatric medication

**SYMPTOMS OF MDD MAY INCLUDE:**  
Sadness  
Hopelessness  
Depressed mood  
Problems sleeping  
Difficulty concentrating  
Lack of motivation


Joining this research study provides you with an opportunity to contribute to the understanding of MDD, which affects millions of Americans. Compensation is provided.

**For more information, please call LIBR at:**  
918-502-5100

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**LIBR**  
Laureate Institute for Brain Research

**JOIN A RESEARCH STUDY**  
TO IMPROVE MENTAL HEALTH THROUGH NEUROSCIENCE



**WELLNESS CARE BY DIETING AND FITNESS**  
ENERGY FITT LIVING HAPPY LIFESTYLE

The Laureate Institute for Brain Research (LIBR) in Tulsa, OK is looking for volunteers to join our treatment studies that aim to personalize mental health care through neuroscience. Volunteers are needed with and without symptoms of depression and anxiety. You will be paid for your participation. Your information will remain confidential. No insurance is required.

**Call for more information: (918) 502-5100**  
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**Curious about anxiety?**  
JOIN OUR STUDY



Find out if you qualify  
CALL 918-344-8611

**LIBR**  
Laureate Institute for Brain Research

**ABOUT OUR RESEARCH**  
This study aims to explore how anxiety relates to the way we think, feel, and make decisions, as well as how our brain responds to various situations. As a participant you will complete tasks that trigger parts of your brain involved in decision making and other thought processes. To see what's happening in your brain, we will use magnetic resonance imaging (MRI), a very safe technology that takes live images of your brain as it's working.

**WE NEED YOU**  
You may be eligible for this study if you:  
• Are 18 to 55 years old  
• Are male OR female  
• Experience high anxiety  
OR  
• Do not experience any significant mental health symptoms.  
You will be paid for your participation.

**SYMPTOMS OF ANXIETY**  
Fear of or distress in social situations, such as public speaking  
Fear of or distress in performance situations, such as taking tests  
Exaggerated or persistent worry about a number of different aspects of life  
Panic attacks  
Muscle tension  
Difficulty sleeping  
Irritability

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**LIBR**  
Laureate Institute for Brain Research

**JOIN A TEEN STUDY**

**ABOUT OUR RESEARCH**  
LIBR is a groundbreaking research facility that uses neuroscience to help improve mental health worldwide. We are looking for teenage research participants from the Tulsa area to help us improve our understanding of mental health disorders through the use of magnetic resonance imaging (MRI), behavioral testing and biological markers. Research at LIBR may help us to improve treatment outcomes. Understand the role of adverse childhood events in the development of mental health disorders. Improve community partnerships that lead to the better mental health care.

**STUDY PARTICIPATION**  
Studies at LIBR typically include questionnaires and testing on a computer, interviews with a researcher, brain imaging scans and the collection of biological samples. Some studies can be completed in a single visit, while others involve multiple visits. Participation is always voluntary and your information is kept confidential. All study assessments and procedures will be provided free of charge to you. No insurance is necessary. You will be paid for your time spent participating in all studies at LIBR.

**WE NEED YOU**  
Qualified teen research volunteers must be:  
• Ages 13-17, male or female  
AND  
• Free of psychiatric symptoms OR  
• Currently experiencing symptoms of anxiety or depression  
• Accompanied by a parent or legal guardian

**For more information, please call LIBR at:**  
918-502-5142

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**Help Us Learn More About Well-Being!**


**LIBR**  
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**THE SUBJECTIVE WELL-BEING STUDY**

The purpose of this research is to understand how individuals from diverse cultures experience well-being and how this affects decision-making and social relationships. Financial compensation is provided.

**Research Participation Involves:**  
• Psychological assessments  
• Brain activity recording (EEG)  
• Behavioral decision-making tasks

**WE NEED YOU!**  
You may be eligible if you are:  
• 18 to 65 years old  
• Male OR female  
• From a diverse cultural background



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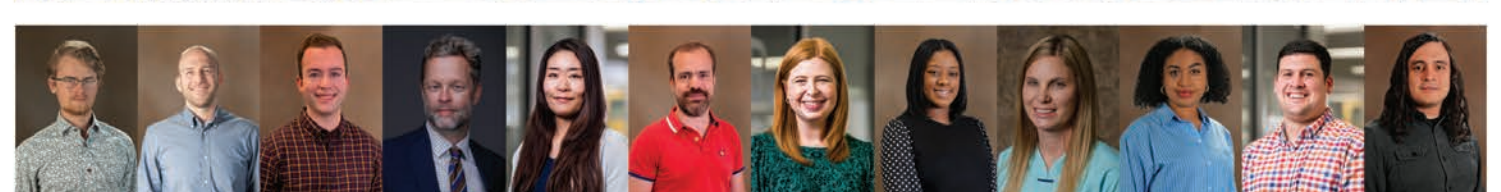
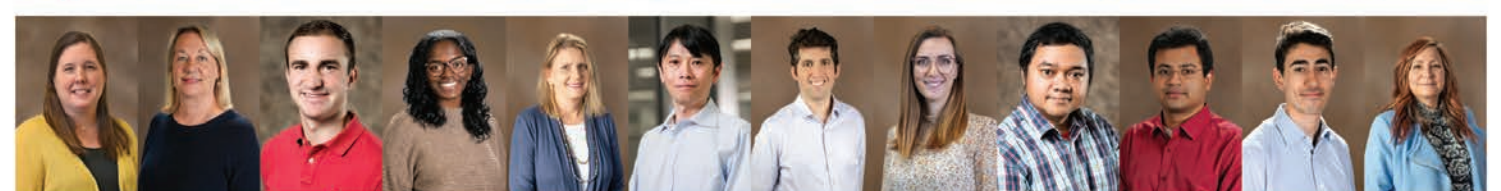
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