Center for Biomedical Imaging

Annual Report
FY2022

(issued August 2022)

The Center for Biomedical Imaging provides resources for enabling basic and clinical scientists to discover new insights into normal and disease processes and apply this knowledge to clinically relevant research.

MUSC
MEDICAL UNIVERSITY of SOUTH CAROLINA

Introduction & Background

The Center for Biomedical Imaging (CBI) was established by the Board of Trustees in 2010 as a *University Designated Center* under the direction of the Vice President for Research. This initiative has enabled MUSC to be competitive with other leading academic institutions by establishing and maintaining the infrastructure and collaborative environment needed to support advanced biomedical imaging research.

The CBI facilities are located in the 30 Bee Street Building and on the second floor of the Bioengineering Building at 68 President Street. It is administered through the Department of Neuroscience, with administrative offices located on the fourth floor of the Basic Science Building. The CBI is a resource for basic and clinical scientists to discover new information about normal and disease processes and apply this knowledge to clinically relevant research. Central to the mission objectives of the CBI are: 1) service to the MUSC imaging research community, 2) training and mentorship of graduate students and postdocs to help develop future leaders in biomedical imaging, 3) recruitment of outstanding biomedical investigators, 4) discovery of new clinical applications of imaging and their practice in the clinical arena, and 5) promotion of basic research in biomedical imaging and related fields. The CBI's website can be found here.

In fiscal year 2022, the CBI provided imaging support and resources for a total of 54 grants, 35 of which were NIH grants to MUSC (Appendix II). The CBI also supports MUSC faculty by allowing development time to qualified investigators for collaborations and the collection of pilot data. In fiscal year 2022, the CBI underwrote approximately $100K of this development time for MUSC researchers.

Mission Statement:

The mission of the CBI is to provide the leadership and infrastructure in the imaging sciences necessary for basic and clinical scientists to collaborate, to discover new ways to study normal and disease processes, to develop and apply this knowledge to clinically relevant research, and to translate these advances to the patient community while fostering a quality education and training environment.

Vision Statement:

The vision of the CBI is to serve the MUSC community as an integrated and multidisciplinary center for biomedical imaging research with mutually supportive and valued interactions among basic science and clinical departments.

Administration

Leadership:

In FY2022, the leadership of the CBI consisted of:

Dr. Jens H. Jensen, Interim Director
Dr. Hesheng Liu, Associate Director
Dr. Truman R. Brown, Scientific Director
Dr. Maria Fatima Falangola, Associate Director of Preclinical MRI

CBI Internal Advisory Committee:

The CBI's Internal Advisory Committee (IAC) comprises the CBI Directors as well as both early stage and senior researchers from across the University. Many of these individuals are experienced in participating in large research programs as well as in the management of shared facilities. The IAC advises the Director on the administrative operation of the CBI, coordinates resources, and ensures that the goals of the CBI reflect the overall priorities of MUSC.

Members of the IAC in FY2022 were:

Dr. Andreana Benitez	Dr. Hesheng Liu
Mr. Joseph Bennett	Dr. Lori McMahon
Dr. Truman Brown	Dr. Lisa McTeague
Dr. Christopher Cowan (Chair)	Dr. Anand Mehta
Dr. Maria Fatima Falangola	Dr. Lindsay Squeglia
Dr. Jens Jensen	Dr. Thomas Uhde
Dr. Steven Kautz	

CBI leadership holds regular "Advisory Committee Meetings" as well as "Town Hall Meetings" in which all users are able to express their views and opinions. These meetings were held on:

CBI Advisory Committee	**Town Hall**
September 13, 2021	August 24, 2021
January 13, 2022	January 18, 2022
May 17, 2022	May 17, 2022

Business Management:

In FY22, business operations for the CBI were managed by Emily Clark under the supervision of Joseph Bennett, who is the administrative manager for the Department of Neuroscience.

Operations

Faculty & Staff:

The following faculty & staff were fully or partially supported by the CBI in FY2022:

Bennett, Joseph	Administrative Manager
Brown, Truman	Professor, Scientific Director
Clark, Emily	Administrative Coordinator II
Coatsworth, James	3T MRI Program Manager
Doose, Jayce	Biomedical Engineer
Falangola, Fatima	Assistant Professor
Fleury, Tom	Facilities/Information Manager
Henderson, Scott	3T MRI Program Manager
Jensen, Jens	Professor, Interim Director
Nie, Xingju*	7T MRI Research Specialist
Roberts, Donna	Professor
Voltin, Josh*	7T MRI Research Specialist
Smalls, Vonetta	Administrative Assistant

*part-year only

Human imaging Resources:

Human MRI studies take place in the CBI's 30 Bee St. facility, which houses a 3 Tesla (T) Prisma^{fit} MRI system, five interview rooms, office space, a mock scanner, an electronics lab, and a waiting area for subjects. In FY2017, the CBI upgraded the Siemens MAGNETOM Trio 3T MRI system to a Siemens MAGNETOM Prisma^{fit} 3T MRI system. This upgrade has significantly benefited a multitude of National Institutes of Health (NIH) funded researchers, as well as researchers funded from other sources, in the fields of substance abuse, addiction, aging, Alzheimer's disease, Parkinson's disease, attention-deficit hyperactivity disorder, stroke, and basic neuroscience. The scanner operates with a 100% mandate for research and is covered by a Master Research Agreement with Siemens.

The current system is the only human MRI research-dedicated scanner at MUSC, and one of only two human research-dedicated scanners in South Carolina. The mock scanner is a full-size replica of the 3T MRI made from plywood and other building materials designed to look and sound like a real system. It is available for 'trial runs' with patients who are wary of undergoing the full scanning procedure and can be also booked for use as a training or demonstration tool.

Preclinical (Small Animal) Imaging Resources:

The Bruker BioSpec 70/30 MRI scanner is a multipurpose system for high-resolution MR spectroscopy and imaging of small animals. This magnet operates at a field level of 7T and is

located on the second floor of the Bioengineering Building. The 7T MRI is ideal for 2D and/or 3D high-resolution anatomical imaging as well as diffusion, flow, cardiac, dynamic contrast, functional, and chemical shift imaging. Adjacent to the scanner is a surgery room that is available to support imaging studies.

The 7T system is 15 years old and no longer fully supported by the manufacturer. The cold head was upgraded in FY20, but the electronics are now obsolete and would be difficult to repair. A major upgrade of the electronics may be needed within a few years in order to keep the scanner in operation. During the past year, 3 funded studies and 2 pilot projects utilized this resource. Because the CBI's former MRI technologist (Xingju Nie) left MUSC in the fall of 2021, the 7T system was unavailable to research studies for several months while a new MRI technologist (Josh Voltin) could be recruited and trained.

MRI Safety Training:

The CBI staff conducts regular safety training classes for researchers who use CBI resources. In FY22, these were held on 7/14/21, 8/18/21, 9/15/21, 10/11/21, 11/9/21, 12/7/21, 1/11/22, 2/8/22, 3/8/22, 4/5/22, 5/5/22, 5/25/22, and 6/21/22.

MRI Safety Committee:

In FY22, the CBI established an MRI Safety Committee for approving and overseeing safety procedures for both scanners. In particular, ancillary equipment must be approved by this committee prior to being used within the scanner suites. The committee members are Jayce Doose (Chair), Jimmy Coatsworth, Scott Henderson, and Tom Fleury.

Scheduling:

Scheduling of time on imaging systems is performed through a web-based system called Calpendo (https://musc.calpendo.com/) that allows researchers with approved protocols to reserve time for using CBI resources.

Early Stage Investigator Program:

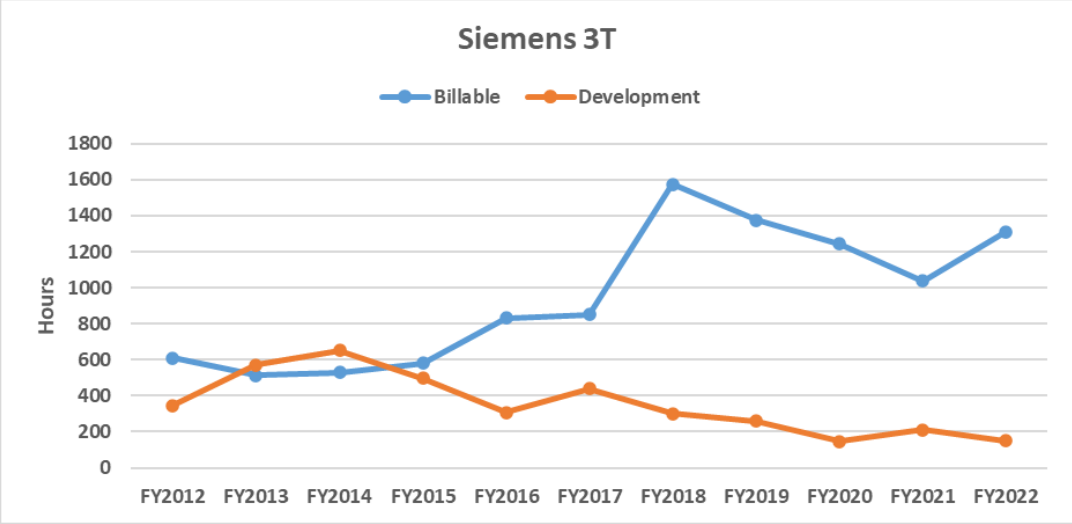
MUSC researchers who qualify as early stage investigators (ESI), according to criteria established by the NIH, are eligible to receive subsidies that partially defray the cost of MRI scans for certain types of small grants. In FY22, the CBI provided a total of $36,888 in ESI subsidies to 9 MUSC faculty and postdocs. This program allows young imaging scientists with limited financial resources to pursue studies that would otherwise not be possible.

Cancellation Reduction Incentive Scheduling Program:

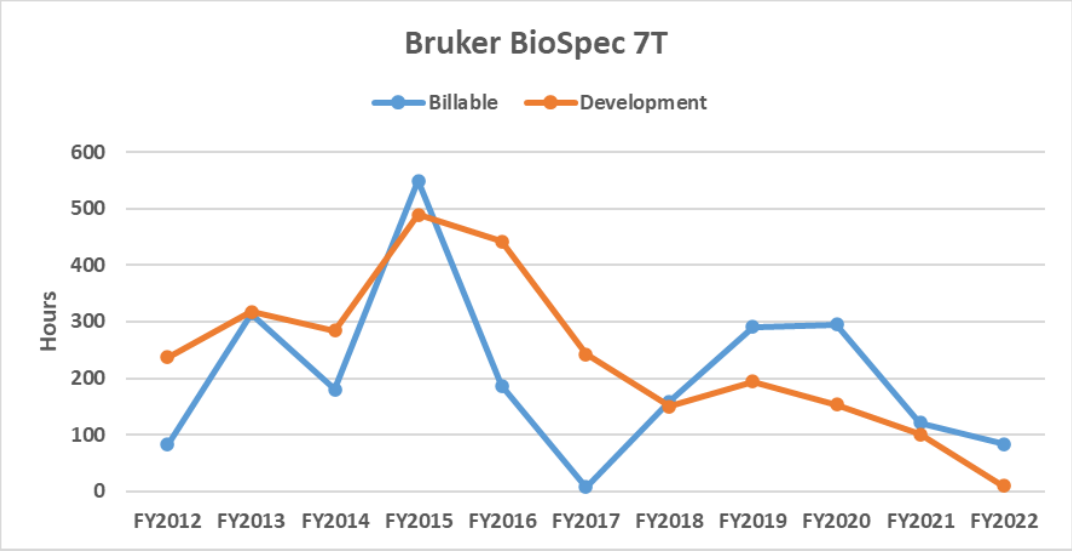
In order to encourage responsible scheduling practices for scans on the 3T MRI system, a Cancellation Reduction Incentive Scheduling Program (CRISP) was established in January of 2020. CRISP provides credits for principal investigators based on their "last minute" (i.e., less than 72 hrs

prior to scheduled scan time) cancellation rate. In FY22, CRISP credits totaled $5064.

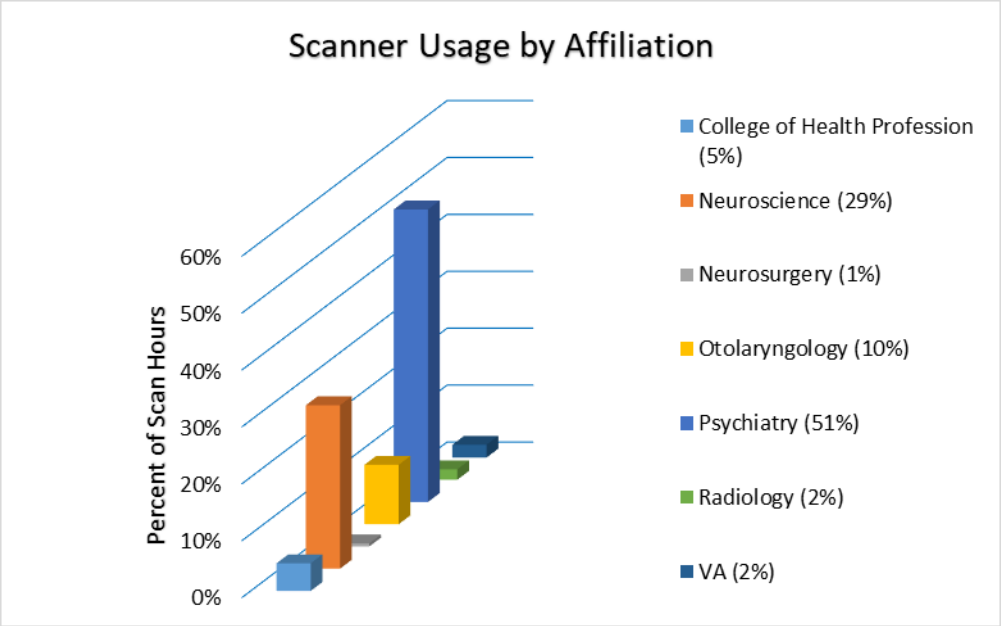
Equipment Usage:



Annual scanner hours used by researchers from FY2012 through FY2022 for the Siemens 3T MRI system. Development time is free of charge but only for restricted purposes.



Annual scanner hours used by researchers from FY2012 through FY2022 for the Bruker 7T MRI system.



Breakdown of scanner usage (combined 3T and 7T) by MUSC department or other affiliation.

Impact of COVID-19 Pandemic:

The impact of the COVID-19 pandemic on CBI operations in FY22 was significant, but substantially less than for FY21. As a result, the number of billable scan hours for the 3T system increased from 1038 hr in FY21 to 1311 hr in FY22, the highest number since FY19. Because of this increase in scan revenue, the net CBI spending did not exceed the approved institutional support of up to $150K/yr (see Appendix I).

In response to the initial COVID outbreak, the CBI developed a comprehensive set of procedures for safe operations. However, as the severity of the pandemic lessened in the Spring of 2022, these special procedures were suspended, as the general MUSC COVID polices were then considered sufficient for safe CBI operations. Nonetheless, CBI leadership continues to monitor the situation closely, and CBI-specific COVID safety procedures will be reinstated if warranted.

CBI Faculty

The CBI is a multidisciplinary group of 25 faculty members and 8 staff representing various clinical and basic science departments at MUSC. Collaboration among faculty in the development of new and cross-disciplinary methodologies is strongly encouraged.

Faculty members contribute imaging-related seminar lectures, provide advice to the CBI leadership, and generally support the overall well-being of the CBI. They are expected to take part in regularly scheduled educational meetings, including the CBI seminars series, which provides a forum for researchers to have in-depth technical discussions. Faculty members are asked to give lectures on their research to the CBI community every few years. The CBI faculty for FY22 are listed below:

Benitez, Andreana, PhD	Associate Professor	Neurology
Bonilha, Leonardo, MD/PhD	Professor	Neurology
Borckardt, Jeffrey, PhD	Professor	Psychiatry
Brown, Truman, PhD	Professor, Scientific Director	Radiology
Eckert, Mark, PhD	Professor	Otolaryngology
Falangola, Maria, MD/PhD	Assistant Professor, Assoc. Dir.	Neuroscience
George, Mark, MD	Distinguished University Prof.	Psychiatry
Harris, Kelly, PhD	Professor	Otolaryngology
Kirstin-Friederike Heise	Assistant Professor	Health Sci. & Research
Helpern, Joseph, PhD	Professor Emeritus	Neuroscience
Hubbard, Catherine, PhD	Assistant Professor	Neuroscience
Jenkins, Dorthea, MD	Professor	Pediatrics
Jensen, Jens, PhD	Professor, Interim Director	Neuroscience
Joseph, Jane, PhD	Professor	Neuroscience
LaRue, Amanda, PhD	Professor	Pathology & Lab. Med.
Li, Xingbao, MD	Associate Professor	Psychiatry
Liu, Hesheng, PhD	Professor, Associate Director	Neuroscience
McTeague, Lisa, PhD	Associate Professor	Psychiatry
Prisciandaro, James, PhD	Associate Professor	Psychiatry
Roberts, Donna, MD	Professor	Radiology
Rowland, Nathan, MD/PhD	Assistant Professor	Neurosurgery
Spampinato, Vittoria, MD	Professor	Radiology
Squeglia, Lindsay, PhD	Associate Professor	Psychiatry
Tipnis, Sameer, PhD	Professor	Radiology
Yu, Xue-Zhong, MD	Professor	Microbiology

Education

Biomedical Imaging PhD Program:

The CBI developed a Biomedical Imaging PhD Program under the direction of Truman Brown. It enrolled 4 students 2016, but has suspended enrolling new students since the number of faculty with technical imaging expertise is no longer sufficient to support a full imaging-focused curriculum. Nonetheless, all 4 students have successfully completed PhDs under this program (2 in 2019, 1 in 2020, 1 in 2022). In place of this comprehensive program, an introductory MRI course is now offered as a neuroscience elective.

CBI Seminars:

The CBI regularly hosts lectures given by both visiting speakers and CBI faculty. For the past four years, these have been organized by Drs. Kelly Harris and Lisa McTeague. CBI seminars for FY22 are listed below:

Date	Presenter	Title	Institution
9/8/2021	Jongho Lee, PhD	Imaging myelin and iron in the brain	Seoul National University
10/11/2021	Simon Eickhoff, PhD	Brain mapping and individual predictions	Heinrich-Heine-University
11/10/2021	Kara Leyzac, PhD	How the health of the auditory nerve relates to speech recognition outcomes in cochlear implant users	MUSC
12/8/2021	Lindsay Squeglia, PhD	Early substance use findings from ABCD data	MUSC
1/12/2022	Daniel Pine, MD	Advancing psychiatric care through clinical neuroscience	NIMH/NIH
2/9/2022	Cynthia Rogers, MD	Neonatal brain connectivity and childhood psychopathology	Washington University School of Medicine
3/9/2022	Helge Zoellner, PhD	Modeling matters: new methods for reproducible MRS data analysis	Johns Hopkins University
4/13/2022	Edmund C. Lalor, PhD	Electrophysiological investigations of natural speech and language processing	University of Rochester Medical Center
5/11/2022	Kirstin-Friederike Heise, PhD	Intrinsic and extrinsic modulation of sensorimotor	MUSC

		control strategies - Insights into changes throughout the adult lifespan	
6/8/2022	Eric Berman, MD	Testing in neuro-opthalmology, focusing on OCT (optical coherence tomography)	MUSC
7/13/2022	Katherine Dunlop, PhD	Defining Subtypes of Escitalopram Response Using Resting-State fMRI	University of Toronto

CBI Featured Images:

The CBI website periodically features images that highlight imaging-related research by MUSC investigators. For FY2022, CBI featured images were contributed by Emilie McKinnon (Jensen lab), Jane Joseph, Catherine Hubbard, Xingbao Li, Hunter Moss (Jensen lab), Claudia Salazar (Rowland lab), and Anna Kirkland (Squeglia lab).

Appendix I: End-of-Year Budget

FY22 EOY Budget					
Budget Category	**Admin**	**3T**	**7T**	**Totals**	**% of Category Total**
Revenue					
Scan Revenue	$ -	$ 780,175	$ 22,250	$ 802,425	100.00%
Revenue Total	**$ -**	**$ 780,175**	**$ 22,250**	**$ 802,425**	**100.00%**
Expenses					
TOTAL PERSONNEL	**$ 42,534**	**$ 450,052**	**$ 59,022**	**$ 551,607**	**62.08%**
50202 Utilities	$ -	$ 9,757	$ -	**$ 9,757**	1.10%
50204 Repairs	$ -	$ 3,197	$ -	**$ 3,197**	0.36%
50207 Other Contractual Service	$ -	$ 149,676	$ -	**$ 149,676**	16.85%
50209 Telephone (Centrex)	$ 1,057	$ 724	$ 393	**$ 2,174**	0.24%
50216 SUBSIDY Internal Service Charges	$ 42,016	$ 50	$ 80	**$ 42,146**	4.74%
50242 Maintenance Contracts	$ -	$ 6,909	$ 72,341	**$ 79,250**	8.92%
50304 Office Supplies	$ -	$ 235	$ -	**$ 235**	0.03%
50306 Med/Sci/Lab Supplies	$ 70	$ 6,773	$ 730	**$ 7,573**	0.85%
50201, 50312 Postage	$ -	$ 7	$ -	**$ 7**	0.00%
50349 Additional Software Licenses	$ 40	$ 283	$ -	**$ 323**	0.04%
50349 Calpendo License	$ -	$ 6,015	$ -	**$ 6,015**	0.68%
50401 30 Bee Street Lease	$ -	$ 29,354	$ -	**$ 29,354**	3.30%
50409 Insurance (Commercial, Hazard/Flood)	$ -	$ 7,183	$ -	**$ 7,183**	0.81%
TOTAL COSTS	**$ 43,183**	**$ 220,164**	**$ 73,544**	**$ 336,891**	**37.92%**
Total Expenses	**$ 85,717**	**$ 670,216**	**$ 132,566**	**$ 888,498**	
% of Total Expenses	10%	75%	15%	100%	
Net Income	**$ (85,717)**	**$ 109,959**	**$ (110,316)**	**$ (86,073)**	
Institutional Support				**$ 86,073**	
FY22 TOTAL				**$ (0)**	

Appendix II: Grants Supported by CBI for FY22

PI	Funding Source	Grant Title
Sudie Back	**NIAAA**	Oxytocin to Enhance Integrated Exposure-Based Treatment of Co-occurring Alcohol Use Disorder and PTSD
Bashar Badran	**NIH COBRE**	Optimization of Closed-loop Transcutaneous Auricular Vagus Nerve Stimulation (taVNS) as a Neurorehabilitation Tool
Andreana Benitez	**MN4R**	High-dose Accelerated rTMS to Cognitive Control Neurocircuitry in MCI: A Safety and Feasibility study
Andreana Benitez	**NIDA**	MUSC Specialized Center of Research Excellence (SCORE) on Sex Differences: Stress-Reactivity and Cannabis Use in Cannabis-Using Older Adults
Andreana Benitez/Joseph Helpern	**NIA**	Quantitative Neuroimaging Assessment of White Matter Integrity in the Context of Aging and AD
Leonardo Bonilha	**NIDCD**	Optimized Intracranial EEG Targeting in Focal Epilepsy based upon Neuroimaging Connectomics
Leonardo Bonilha	**NIDCD**	Telerehabilitation for Aphasia
Mark Bowden	**NIDA**	Contributions to Impaired Walking
Olga Brawman-Mintzer	**VA**	ADNI3
Truman Brown	**NIMH**	EEG/fMRI Controlled TMS Real-Time Neural Feedback in Anti- Depressive Treatment
Carla Kmett Danielson	**NIMH**	Threat-related negative valence systems, child victimization, and anxiety
Carla Kmett Danielson	**NIMH**	Impact of Race-related violence exposure
James Dias	**Hearing Health Foundation**	Neural Determinants of Age-Related Change in Auditory-Visual Speech Processing
Mark Eckert	**NIDCD**	Experimental and Clinical Studies of Presbyacusis
Julianne Flanagan	**NIAAA**	Oxytocin to enhance alcohol behavioral couple therapy

Mark George	**Tiny Blue Dot Foundation**	T1 structural scan for TMS-EEG project
Mark George	**Tiny Blue Dot Foundation**	Clinical Feasibility of Low Intensity Focused Ultrasound Pulsation for the Treatment of Generalized Anxiety Disorder
Kelly Harris	**NIDCD**	Neural determinants of sound encoding in the aging ear and brain
Kelly Harris	**NIDCD**	Experimental and Clinical Studies of Presbyacusis
Vanessa Hinson	**UCB SA**	A double-blind, placebo-controlled, randomized, 18 month Phase 2a study to evaluate the efficacy, safety, tolerability, and pharmacokinetics of oral UCB0599 in study participants with early Parkinson's Disease
Amber Jarnecke	**NIAAA**	Identifying the neurobehavioral signature of individuals with AUD and comorbid PTSD
Jens Jensen	**NIDA**	Establishing the Neurostructural and Clinical Impact of Brain Iron Dysregulation in Cocaine Use Disorder
Jane Joseph	**NIA**	Using connectomics to characterize risk for Alzheimer's Disease
Jane Joseph	**DOD**	Connectome biomarkers for predicting Alzheimer's risk in traumatic brain injury
Jane Joseph	**Center on Aging Grant**	Alcohol use disorder and connections to Alzheimer's disease
Xingbao Li	**NIDA**	RTMS targets to neural circuity for smoking cessation
Hesheng Liu	**NIDA**	Neurocircuit Strategy to Decrease Cocaine Cue Reactivity
Lisa McTeague	**NIAA**	MPFC Theta Burst Stimulation as a Treatment Tool for Alcohol Use Disorder: Effects on Drinking and Incentive Salience
Lisa McTeague	**VA**	Developing a Novel rTMS Intervention for Transdiagnostic Psychosocial Rehabilitation: A Dose-finding Study
Lisa McTeague	**Brain and Behavior Research Foundation**	Accelerated Repetitive TMS for Affective Dysfunction: Establishing the Dose-Response Curve
Lisa McTeague	**NIGMS**	Neuromodulation of cognitive control neurocircuits for stroke rehabilitation
William Mellick	**NIAAA**	Imaging Framework for Testing GABAergic/glutamatergic Drugs in Bipolar Alcoholics

William Mellick	**NIAAA**	Effects of a Novel mGluR5 Negative Allosteric Modulator on Alcohol Drinking, Neurochemistry, and Brain Reactivity to Alcohol Cues in Alcohol Use Disorder
Nicholas Milano	**Biogen**	Multicenter, Safety Study of BIIB037 (aducanumab) in Subjects with Alzheimer's disease Who Had Previously Participated in the Aducanumab Studies 221AD103, 221AD301, 221AD302 and 221AD205
Jacobo Mintzer	**VA**	Long-Term Nicotine Treatment of Mild Cognitive Impairment
Jacobo Mintzer	**NIA**	Anti-amyloid treatment in asymptomatic Alzheimer's Disease (A4)
Jacobo Mintzer	**VA**	Observational study of cognitively normal, non-amyloidopathic subjects parallel to the A4 Study
Jacobo Mintzer	**National Endowment for the Arts & AARP**	To support a randomized experiment testing music's impact on the brains of older adults with moderate-to-severe Alzheimer's disease
Besim Ogretmen	**SmartState Endowment**	Effects of sphingolipid alterations in glioblastoma growth in mice models
James Prisciandaro	**NIDA**	Gabapentin for Restoring GABA/gultamate Homeostasis in Co-occurring Bipolar and Cannabis Use Disorders: A Randomized, Double-blind, Placebo-controlled, Parallel-group,
James Prisciandaro	**NIAAA**	Imaging Framework for Testing GABAergic/glutamatergic Drugs in Bipolar Alcoholics
Gonzalo Revuelta	**Other**	Gait Task in Parkinson’s Disease (TMS/FOG)
John Rhodes	**NHLBI**	Does the mind has ability to resist damage of brain after CHD
Donna Roberts	**Translational Research Institute for Space Health**	Safety and Efficacy of an Accelerated Protocol of Intermittent Theta Burst Transcranial Magnetic Stimulation (TMS) to Enhance Performance and Promote Resilience in Astronauts
Nathan Rowland	**Other**	Effect of transcranial direct current stimulation on cortical oscillations during a virtual reality task

Michael Saladin	**NIDA**	Behavioral & Integrative treatment development program
Rodney Schlosser	**NIDCD**	Olfactory Dysfunction in Aging Adults
Chris Sege	**NIMH**	Modeling and Modulating Mechanisms of Escape, Avoidance, and Approach in the Anxiety Disorder Spectrum
Na Jin Seo	**NICHD**	Concomitant sensory stimulation during therapy to enhance hand functional recovery post stroke
Lindsay Squeglia	**NIAA**	Neuroscience-informed treatment development for adolescent alcohol use
Lindsay Squeglia	**NIDA**	The Adolescent Brain Cognitive Development (ABCD) Study
Lindsay Squeglia/ Anna Kirkland	**SCORE**	Investigating Neural and Microbiome Sex Differences in Adolescent Alcohol Use
Stephan Tomlinson	**NINDS**	Role of complement in TBI
Yongren Wu	**NIDCR (sub award)**	Improvement of animal models for stem cell-based TMJ regeneration

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