PENN BRAIN SCIENCE,
TRANSLATION, INNOVATION,
AND MODULATION CENTER

brainSTIM Center

# brainSTIM

# Year In Review

# 2022

**Perelman School of Medicine**
**University of Pennsylvania**

# brainSTIM

**Penn Brain Science, Translation, Innovation, and Modulation Center**




The brainSTIM Center would like to thank Ava Leone for her assistance with this Year in Review.

# From the Director

Dear brainSTIM family,

I want to thank all the faculty, staff, and supporters who have contributed to brainSTIM's ongoing success, and I'm delighted to share our progress with you.

In 2022, brainSTIM continued to grow as an organization. We were excited to welcome two new faculty members, Michael Beauchamp, PhD and Daniel Barbosa, MD. Dr. Beauchamp, a Professor in the Department of Neurosurgery, pursues groundbreaking research on multisensory speech perception which employs intracranial electroencephalography (iEEG) and blood-oxygen level dependent functional magnetic resonance imaging (BOLD fMRI), as well as the neuromodulation techniques transcranial and intracranial stimulation. Dr. Barbosa, a Senior Research Investigator in the Department of Neurosurgery, has been partnering with neurosurgeon and brainSTIM core faculty member Casey Halpern, MD to treat binge eating disorder with deep brain stimulation. They discovered that a brain implant, similar to a pacemaker, can stop binge eating impulse, a finding that has garnered attention from major media outlets, including NBC News, CBS News, The New York Times and more. Many other brainSTIM faculty have enjoyed remarkable scientific successes, often in collaboration with each other and with other members of the Penn community. In addition to expanding its presence at Penn, brainSTIM has made itself known far beyond the walls of the University. In partnership with the Mahoney Institute for Neurosciences (MINS), brainSTIM hosted the MINS/brainSTIM Year of Neuromodulation. This year-long celebration of neuromodulation featured invited lectures from national and international luminaries in the field, and provided a platform both for promoting cutting-edge science and for introducing the broader neuromodulation community to the wealth of talent here at Penn.

The MINS/brainSTIM Year of Neuromodulation culminated in the late spring with a symposium that included some of the world's most highly recognized experts in the field.

Through its ongoing commitment of its faculty, staff, and many supporters, brainSTIM has continued to thrive and deliver on its goal of fostering trailblazing, multidisciplinary neuromodulation research at the University of Pennsylvania.

I want to thank everyone who committed their ideas, energy, time, and support to ensuring the success of brainSTIM. Please enjoy this annual review, and here's to a happy, healthy, and productive 2023!

Roy Hamilton, MD, MS

# Center Initiatives

## The brainSTIM Center's initiatives are focused on expanding training, increasing outreach and promoting a collaborative environment.


*Photo courtesy of The Franklin Institute.*

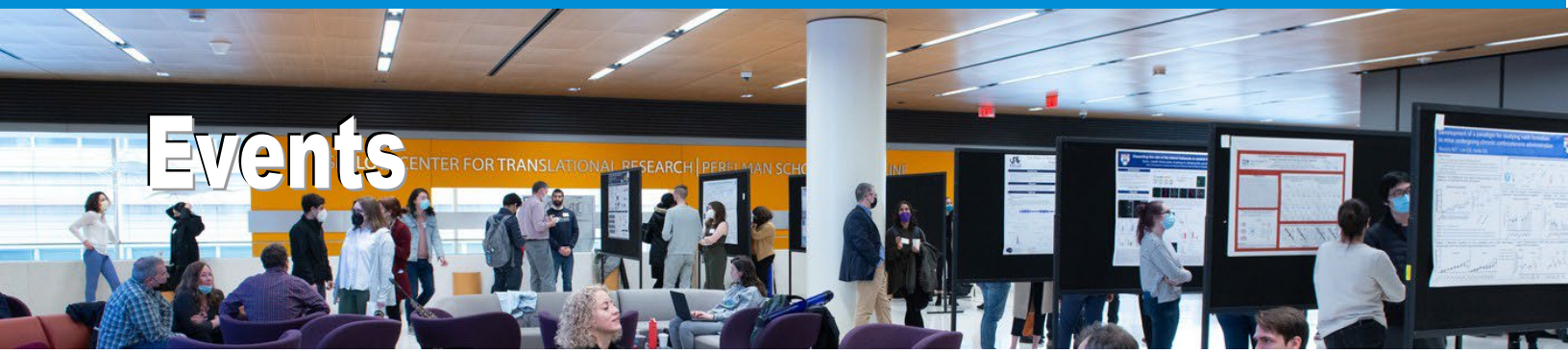
## EDUCATION

The Center is developing a curriculum for transcranial magnetic stimulation (TMS) to provide members of the Penn research community and others with the opportunity to receive training in the use of this important clinical and research neuromodulation tool. This initiative is led by Mario Cristancho, MD, Associate Professor of Clinical Psychiatry, and Nicholas Balderston, PhD, Research Professor of Psychiatry, in collaboration with multiple brainSTIM Center faculty, all of whom are widely-recognized experts in clinical and/or research applications of TMS. In the coming year, we will kick off this effort by hosting an inaugural multi-day workshop, which will include lectures, hands-on training sessions, panel discussions, and networking events. Our ultimate goal will be to develop a robust curriculum that will serve as a resource to TMS researchers, educators, and clinicians within and outside of Penn, and a model for future brainSTIM curricula related to other neuromodulation technologies.

A second training opportunity being developed by brainSTIM is the creation of summer research internships for undergraduate students interested in topics in neuromodulation. This summer, the Center is collaborating with the departments of Neurology and Psychiatry to host its first undergraduate trainee in what we anticipate will be an ongoing, annual program. In line with the Center's commitment to enhancing diversity, this internship will focus on promoting research participation among persons who belong to groups that are underrepresented in the fields of science, medicine, and neuromodulation.

## CLINICAL AND INDUSTRY PARTNERSHIPS

The Center continuously strives to raise awareness of the University of Pennsylvania and the investigators who comprise brainSTIM as a 'go-to' resource for scientific and clinical expertise related to neuromodulation and related techniques. This includes a growing number of partnerships with industry to conduct clinical trials that employ neuromodulation approaches as novel disease treatments, as well as nonclinical human subjects trials geared toward developing stimulation devices for commercial applications in healthy populations. More broadly, brainSTIM fosters communication between industry partners and neuromodulation researchers for the purposes of establishing collaborations that promote the development of novel technologies and innovative applications of invasive and noninvasive brain stimulation. Looking ahead, the Center also aims to develop a clinical and research infrastructure that will enable neuromodulation-focused clinicians and researchers to collaborate seamlessly in order to run research studies and clinical trials, and to administer novel, investigational applications of neuromodulation technologies in clinical populations who are resistant to or poorly-suited for conventional therapies.



# Events

## Year of Neuromodulation Symposium

We reported in last year's Year in Review on the brainSTIM Center's partnership with the Mahoney Institute for Neurosciences (MINS) to host the "MINS/brainSTIM Year of Neuromodulation". The year-long event provided an opportunity to engage global leaders in the field of neuromodulation as invited speakers, host symposia that highlighted cutting-edge advances in brain stimulation, and to showcase the outstanding work being done at the University of Pennsylvania. The grand finale of the MINS/brainSTIM Year of Neuromodulation was the 37th Annual MINS Symposium held on April 6, 2022, organized by both MINS and the brainSTIM Center. The full day symposium was the culmination of the Year of Neuromodulation and was a packed day of very exciting presentations and posters.

From left to right front row: Drs. M. Shanechi, A. Pascual-Leone, T. Tritto and J. Dani. Back row: Drs. F. Vitale and M. Beauchamp.

Dr. Alvaro Pascual-Leone presenting the Adler Lecture.

The day kicked off with the Adler Lecture given by Alvaro Pascual-Leone, MD, PhD, from Hebrew SeniorLife, Harvard Medical School, and a member of brainSTIM's External Advisory Board, with a talk entitled "Promoting Brain Health and Addressing Brain-Related Disabilities". Maryam Shanechi, PhD, from the University of Southern California was the Rising Star Award recipient and was presented with a framed certificate along with a $10,000 prize. Her lecture that followed the presentation was "Next-Generation Brain-Machine Interfaces to Realize Personalized Neuromodulation."

Dr. Roy Hamilton presenting Rising Star Award to Dr. Maryam Shanechi.

## Year of Neuromodulation Symposium

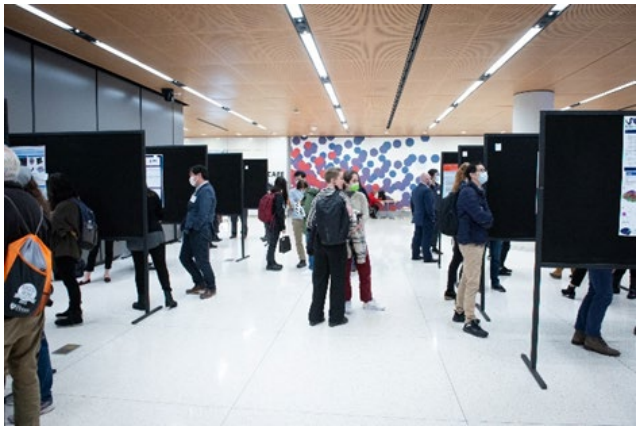
Dr. Flavia Vitale and Dr. Desmond Oathes, minisymposia chairs.

The day also included minisymposias chaired by brainSTIM faculty members, Flavia Vitale, PhD, and Desmond Oathes, PhD, and included talks by brainSTIM faculty Casey Halpern, MD, and additional faculty, post-doctoral fellows, and research associates from UPENN. The event finished with poster awards and our final named lecture, the Sprague Lecture, given by Warren Grill, PhD, from Duke University entitled "Closed-Loop Brain Stimulation".

The day was well attended and was an outstanding way for brainSTIM scientists to connect with preeminent leaders in the field of brain stimulation, present their own innovative research, and elevate interest in neuromodulation within the Penn academic community and beyond.

Dr. Warren Grill presenting the Sprague Lecture.

Drs. R. Hamilton, M. Shanechi, A. Pascual-Leone, W. Grill, J. Dani.



Dr. Roy Hamilton on stage at the "Science Matters: Conversation Lab" at the Franklin Institute.

## Science Matters: Conversation Lab at The Franklin Institute

We were invited by The Franklin Institute in Philadelphia, one of the most celebrated science museums in the US, to help kick off the first session of a new program called " Science Matters: Conversation Lab", on November 9, 2022. These sessions offer an opportunity for members of the public to engage in an informal dialogue with noteworthy experts to promote two-way communication and mutual learning about scientific issues that have social impacts.

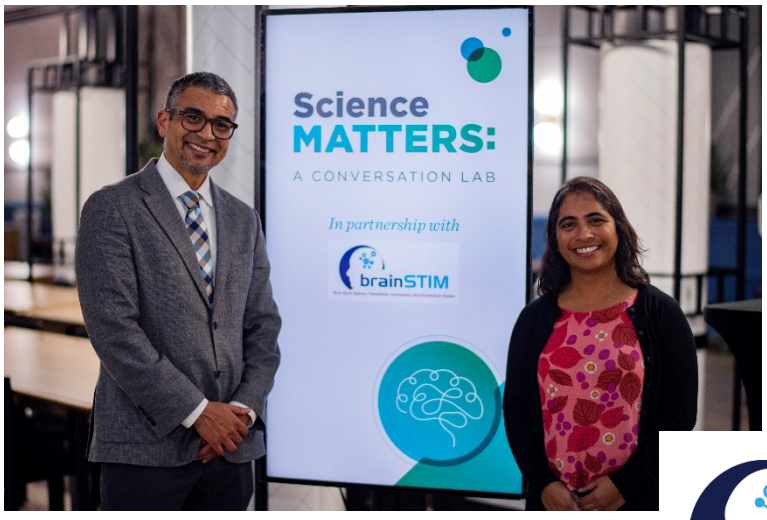

November's inaugural Conversation Lab focused on the topic of brain stimulation for cognitive enhancement. The evening event opened with an introduction by The Franklin Institute's Chief Bioscientist Jayatri Das, PhD, and led into a presentation by Roy Hamilton, MD, MS, who gave an overview of ways modulation is being applied to enhance human cognition. The talk was followed by engaging exercises focused on considering real-world opportunities and challenges, included some personal reflections and thoughts from the audience, and group conversations with scientists leading research in the field that attended the event. There was a great turnout for this evening event, by both the public and many brainSTIM associated faculty that attended as well. The combination of the public with scientists working in the field made for a lively discussion and stimulated great conversation in the community about the use of neurostimulation.


*Photo courtesy of The Franklin Institute.*

# Events

## Science Matters: Conversation Lab at The Franklin Institute

*Photos Courtesy of The Franklin Institute*




Dr. Roy Hamilton (Director, brainSTIM) and Dr. Jayatri Das (Chief Bioscientist, The Franklin Institute)

# Events

## MindCORE/brainSTIM Seminar

brainSTIM collaborated with Penn's MindCORE, Center for Outreach, Research, and Education, to host Aaron Boes, MD, PhD, from the Department of Neurology at the University of Iowa, home to the Iowa Neurological Patient Registry. This Registry is a rich dataset of more than 1000 individuals with focal, acquired brain lesions with detailed cognitive, mood, and personality assessments. In his talk titled, "Brain lesions as a window into the mind," he discussed insights about brain structure-function relationships gleaned from studying these individuals. The talk included stories of individual patients as well as large group studies that incorporated state-of-the-art methods of lesion analysis and lesion network mapping. He discussed recent work on mood and mind wandering and the potential link between them. Click here for more information on MindCORE.

MindCORE
Center for Outreach, Research, and Education
University of Pennsylvania

## CNDS/brainSTIM Lecture Series

Penn's Center for Neuromodulation in Depression and Stress (CNDS) is partnering with brainSTIM to host a Neuromodulation and Neuroimaging Relevant to Affective Disorders Speaker Series. This is a weekly virtual talk series that features the latest advances in neuromodulation and neuroimaging research from investigators around the world. In 2022, the seminar series hosted neuroscientists, psychologists, psychiatrists, from around the globe. Among those included: Corey Keller, MD, PhD, Assistant Professor of Psychiatry and Behavioral Sciences at Stanford University, Chris Baeken, MD, PhD, a psychiatrist and a research professor at Ghent University in Belgium, Alexandra Woolgar, a cognitive neuroscientist and professor of cognitive neuroscience at the University of Cambridge in the United Kingdom, and many more experts. Click here for more information on the CNDS.

# Faculty Spotlight

## Michael Beauchamp, PhD

brainSTIM Core Faculty

**What drew you to work in neuromodulation?**

My interest in neuromodulation began when I started my first faculty position at the University of Texas Medical School in Houston. My colleague Tony Ro, then at Rice University, was a TMS expert and suggested that we should collaborate on studies of multisensory integration. Around the same time, I also started a collaboration with Daniel Yoshor (now Chair of Neurosurgery at Penn) to examine the effects of electrical stimulation on the brains of neurosurgical patients. When you stimulate the visual cortex, people see a flash of light known as a phosphene. One long-term project is to find out if we can use the phosphenes for something useful. For instance, if someone is blind, can you electrically stimulate their brain with a complex pattern so that they "see" something useful, such as letters or spatial landmarks for navigation.

**What is your vision?**

The fun part about being a scientist is that we can do cool experiments and discover new stuff about the brain. Basic science discoveries can seem very abstract, but in the end can make a tremendous practical difference, but it is hard to predict what that will be! Our dream is that by figuring out new ways to stimulate the brain, we will be able to help people who have brain injuries or brain disorders. Currently there are few treatment options for these patients.

**Can you share some projects you're working on?**

In addition to our work on visual prosthetics, my lab focuses on speech perception. It turns out that seeing the face of the person you are talking to makes it a lot easier to understand them. The pandemic has made this very obvious - if you're wearing a mask, it muffles the auditory information and all the visual information from the talker goes away, resulting in a double hit. We've really dug into how the brain puts together auditory and visual speech information. The hope is that these discoveries will eventually help people who have trouble understanding speech, whether it's because of a stroke or because they have language learning issues. That could be through different training paradigms, or through brain stimulation and brain-computer interfaces.

**What is one of your future research endeavors?**

There is a long history in perception research of scientists experimenting on themselves. One of our new projects is based on something that my collaborator John Magnotti (also Penn Neurosurgery faculty) and I noticed in our own perceptual experience. There is an illusion called the McGurk effect that has been around for decades. In this illusion, the talker's voice and the talker's face don't match. Instead of perceiving what the voice or the face is saying, people experience a fusion percept that is different from the voice and the face. John and I frequently used a video from YouTube to demonstrate the McGurk effect. After many years, we noticed that we didn't need to look at the screen anymore: even without seeing the face, we still experienced the illusion! Perceptual aftereffects are common: if you stare at a red wall for a while, then look at a white wall, it will appear green. But aftereffects usually go away after a few seconds or minutes. But the McGurk aftereffect experienced by John and I seemed permanent. Now, we are seeing if we can repeat this phenomenon in other people with a few minutes of training. This could potentially be useful as a treatment strategy, because if I can change how language sounds to you, maybe it can help people who have trouble understanding language.

**"In all the places in the world, there's very few places that have this many great neuroscientists in such a small place."**

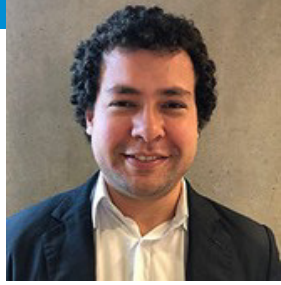
**What is it like working at brainSTIM?**

It's wonderful. Of all the universities and research institutes in the world, there are very few that have this many great neuroscientists in one building [Richards/Goddard]. And especially neuroscientists working on the human brain at the systems level. Most of neuroscience focuses on the cellular and molecular levels, so to have this many investigators interested in how the whole brain functions as a unit, it's really unique.

# Faculty Spotlight

## Daniel Barbosa, MD

brainSTIM Center Scientist



**What drew you to work in neuromodulation, and why?**

Since I was a kid, I was interested in neurology and the brain. Coincidentally or not, I have lived with essential tremor since childhood. I saw many neurologists, and thought, "that's really interesting, how my hands' movements are related to specific areas of my brain." After going to medical school, I learned there was a brain circuit responsible for controlling and fine-tuning movements. Nowadays, we have means to directly target this motor circuit, and to improve its functioning in some cases. Thus, can be indicated for patients with essential tremor or Parkinson's disease, for example, they can have electrodes implanted in their motor circuits. The brain stimulation results never cease to amaze me. We have the means to focally target a brain circuit and make drastic changes in patients' lives. Imagine what we can accomplish as we learn how to best target other circuits involved in different brain disorders?

**What is your vision?**

My vision speaks a little bit to how we're approaching obesity at the Halpern Lab — focusing on loss of control eating and how to reestablish self-control. The idea is to really employ a transdiagnostic approach for the therapeutical modulation of brain circuits underlying specific symptoms, which can be common to a multitude of neurological and psychiatric conditions. For example, the idea of reestablishing self-control over certain impulses can be extremely helpful for someone struggling with addiction or it can be someone with severe impulse control disorders. We should be able to approach patients with neurological or psychiatric conditions from the framework of what symptoms we are trying to target and through which brain circuit(s) we can accomplish a therapeutic response. We may envision many brain symptoms as disorders of circuits that can be targeted with neuromodulation.

**Can you share some projects you are working on?**

The big project we have been working on for a while in the Halpern Lab and that we brought here to Penn from Stanford is the responsive deep brain stimulation (DBS) for binge eating study. We aim to shift the paradigm of how we treat this behavior, which is associated with severe obesity and treatment refractoriness. We also have another project that represents something very novel and exciting at the Halpern Lab. It's now being reviewed by the IRB, so there are a few details which are still being worked out. We are trying to develop a new approach for DBS in obsessive-compulsive disorder (OCD). In a way, we're going to approach OCD similarly to how we approach a different neural circuit disorder, epilepsy. We will have a stereo-EEG procedure to implant depth electrodes and leverage intracranial electrophysiology to map areas of the brain that might be related to the circuits underlying OCD symptoms. Then, we will define which targets and circuits appear to be more helpful for each patient. In a nutshell, we will be doing invasive brain mapping to guide the personalized chronic DBS treatments for OCD. We're very excited. It involves a lot of regulatory steps to put together something like this. We have had the initial FDA approval since last year, and now are getting the IRB approval hopefully in the next couple of months, to start the study here at Penn.

**What is one of your future research endeavors?**

To find a way to predict the side effects of neuromodulation. Sometimes we turn on the DBS therapy for Parkinson's disease and we only observe a side effect several months later, esp. when we think of those related to complex cognitive functions. While rare, the possibility of cognitive side effects can prevent patients with pre-existent cognitive impairment to be eligible for DBS. This means patients are unable to benefit from a very effective therapy because we cannot prevent and avoid relatively rare side effects. On the other hand, sometimes we also have unexpected positive effects of DBS, such as improvement in mood and motivation, which may indicate that we can tap into brain circuitry that improves symptoms beyond the classical motor symptoms. We must strive for more predictable, circuit-based stimulation therapies that can be personalized for a variety of clinical scenarios and novel indications.

**Can you describe what it is like collaborating with other brainSTIM researchers?**

It has been outstanding! It feels like a steal, everything you need, you can find here. If you need someone to give an input on what may happen to patients if you target a certain area of the brain, you have experts to discuss with. Need someone to discuss how can we evaluate for this side effect? You have everyone here. Recently, we have been developing a project to explore potential behavioral and cognitive effects of DBS in the context of movement disorders. I can just send an email or have a call with world-experts in cognitive and behavioral neurology and brain stimulation, such as Roy [Hamilton] or Branch [Coslett]. It's remarkably easy to talk to people and to tap into this extraordinary and multidisciplinary pool of knowledge at brainSTIM. The informal and open communication allows people to come up with new projects, new approaches to treatments, and ways to push the field forward.

**"Having a center where people from neurology, psychiatry, and neurosurgery can talk, interact, discuss, and run ideas by each other because they have different approaches to brain disorders – this will be the future of brain medicine."**

# Core Faculty Highlights

### Casey Halpern, MD

**Associate Professor of Neurosurgery**
**Chief of Stereotactic and Functional Neurosurgery**

Dr. Halpern published ground-breaking pilot work in *Nature Medicine* examining the effects of deep brain stimulation on food cravings in two women living with binge-eating disorder and obesity. The article received a lot of media interest as a potential new intervention for weight loss. See Publications and Media Sections for more information.

### John Medaglia, PhD

**Assistant Professor of Psychology and Neurology, Drexel University**
**Director of the Cognitive Neuroengineering and Well-Being Laboratory (CogNew)**
**Adjunct Assistant Professor of Neurology, UPENN**

In 2022, Dr. Medaglia received the Provost's Award for Outstanding Early-Career Scholarly Achievement at Drexel University (see Awards Section). Along with multiple members of brainSTIM, he is using a new technology called gluCEST, a glutamate-weighted chemical exchange saturation transfer 7T magnetic resonance imaging (MRI). He is using gluCEST MRI in an innovative way to shed light on how TMS can cause physiological changes in the brain, which could help experts form individualized TMS treatments in the future.

### Desmond Oathes, PhD

**Assistant Professor of Psychiatry**
**Co-Director of the brainSTIM Center**
**Associate Director of the Center for Neuromodulation in Depression and Stress (CNDS)**

Dr. Oathes was part of many publications with brainSTIM colleagues in 2022 including one in *Science Advances* that can be found in the Publications Section. Dr. Oathes was also featured in a public lecture hosted by UPenn entitled "NeuroSciFi: The Final Frontier Inside our Heads", a seminar with 15-minute TED style talks from three Philadelphia-area neuroscience faculty members.

# Core Faculty Highlights

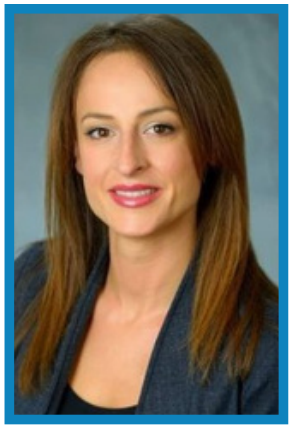
### Yvette Sheline, MD, MS

**McLure Professor of Psychiatry, Radiology & Neurology**
**Director of the Center for Neuromodulation in Depression and Stress (CNDS)**

Dr. Sheline continued her research on how TMS can treat anxiety and depression, publishing multiple research articles in 2022. She received a Milken Institute grant for her research on the use of high dose spaced theta-burst stimulation for the reduction of bipolar depression symptoms, and a NIH grant to support her clinical trial examining a new psychotherapeutic strategy, closed loop real-time fMRI neurofeedback therapy, to reduce severe depression symptoms.

### Flavia Vitale, PhD

**Assistant Professor of Neurology, Bioengineering, Physical Medicine and Rehabilitation**



Dr. Vitale continued her research this year on novel bioelectronic interfaces for studying disorders of the nervous and neuromuscular systems. Her published work with dry wearable MXene high-density surface electromyograhy (HDsEMG) arrays (MXtrodes) showed the advantages and translatability of MXene-based wearable bioelectronics for studying neuromuscular function and disease, and its potential use for precision rehabilitation. She also received the Innovative Application Award at the Neuroergonomics and NYC Neuromodulation Conference in July (see Awards Section).

### Roy Hamilton, MD, MS

**Professor of Neurology, Psychiatry, and Physical Medicine and Rehabilitation**
**Director of Penn's Laboratory for Cognition and Neural Stimulation (LCNS)**
**Director of the brainSTIM Center**

In 2022, Dr. Hamilton published multiple research articles on neuromodulation in collaboration with other brainSTIM members which were featured in *JAMA, NeuroImage, Neuromodulation*, and other peer-reviewed journals. Last year, he became a principal investigator for a new NIH-sponsored three-center multi-site clinical trial that aims to test the efficacy of tDCS as a treatment for primary progressive aphasia, the largest trial of its kind in the world to date.

# Center Scientist Highlights

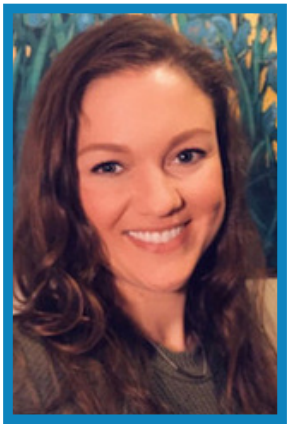
## Nicholas Balderston, PhD

**Research Assistant Professor of Psychiatry**

Dr. Balderston is an experimental psychologist researching mechanisms on how to treat clinical anxiety. He received his first NIH research project grant this year to study the effects of TMS on brain connectivity changes. Along with Dr. Mario Cristancho, he is co-leading brainSTIM's efforts to develop a curriculum for transcranial magnetic stimulation (TMS) (see Center Initiatives Section).

## Denise Harvey, PhD

**Research Assistant Professor of Neurology**
**Research Associate at the Laboratory for Cognition and Neural Stimulation (LCNS)**



Dr. Harvey has continued her work within the lab of Dr. Hamilton, and was part of several publications this year examining language processing and aphasia (see Publications Section). She was also selected to talk at the Academy of Aphasia Annual Meeting about the effectiveness of TMS on aphasia treatment. In 2022, she published multiple articles with Dr. Roy Hamilton, Director of brainSTIM, on how tCDS can help treat primary progressive aphasia and other communication disorders.

## Kelly Sloane, MD

**Co-Primary Investigator at the Laboratory for Cognition and Neural Stimulation (LCNS)**

Dr. Sloane was a recipient of Penn's University Research Foundation pilot award to study the effects of tDCS on post-stroke cognitive impairment in patients undergoing acute inpatient rehabilitation after stroke. She also delivered the keynote address for the 21st Annual John Scholz Stroke Education Conference at the Delaware Academy of Medicine titled, “Innovative Approaches to Stroke Recovery.”

# Highlighted Publications

## Continuous Theta-Burst Stimulation to the Right Dorsolateral Prefrontal Cortex May Increase Potentiated Startle in Healthy Individuals

brainSTIM Center core faculty Drs. Desmond Oathes and Yvette Sheline, along with center scientist Dr. Nick Balderston, published a study exploring the role of right prefrontal cognitive control mechanisms in anxiety using a continuous theta-burst transcranial magnetic stimulation (cTBS). The preliminary results for this study showed that cTBS applied to the dorsolateral prefrontal cortex, an area thought to be involved in anxiety-cognition interactions, made individuals more anxious, rather than less anxious. This study was published in *Biological Psychiatry Global Open Science*, 25 April 2022.

## Aberrant Impulse Control Circuitry in Obesity

Drs. Daniel Barbosa and Casey Halpern, the brainSTIM Center's newest researchers, looked at the circuitry involved in obesity and eating behavior. Using publicly available data, they found that structural connections in ventromedial prefrontal cortex converged ventromedially in the presumed nucleus accumbens (NAc) shell subregion. They further studied the circuit and its relationship to binge eating, and were able to demonstrate in a binge-prone obese female subject that direct stimulation of the NAc shell subregion was associated with a descrease in the number of weekly episodes of uncontrolled eating and decreased BMI. The study concluded that aberrations in this circuit in obesity could be modulated to restore eating behavior control in obesity. This study was published in *Molecular Psychiatry,* Aug 2022 and led to the pilot study described below.

## Pilot Study of Responsive Nucleus Accumbens Deep Brain Stimulation for Loss-of-Control Eating

Dr. Casey Halpern in collaboration with Dr. Daniel Barbosa published results from a pilot study looking at the effects of responsive deep brain stimulation (DBS) on the effects of food cravings preceding loss of control over food consumption. The study showed that over 6 months, there was an improvement of self-control of food intake and weight in two patients with binge eating disorder and severe obesity. This article was published in *Nature Medicine*, Sept 2022 and led to quite a bit of public press around the study (see Media section).

# Highlighted Publications

## Through Thick and Thin: Baseline Cortical Volume and Thickness Predict Performance and Response to tDCS in Primary Progressive Aphasia

In an article published in *Frontiers in Human Neuroscience*, brainSTIM researchers Drs. Nicole Nissim, Denise Harvey, Roy Hamilton and colleagues examined whether cortical thickness and volume in the left hemisphere language network predict transcranial direct current stimulation (tDCS) induced improvements in naming in patients with primary progressive aphasia (PPA). In a surprising result, the authors found that greater middle temporal gyrus thickness and volume, but lower superior temporal gyrus thickness and volume were associated with greater naming improvement in active verses sham stimulation. The results suggest spared or partially spared regions within the left hemisphere are necessary for tDCS induced enhancement of naming in PPA.

## Glutamate-Weighted Magnetic Resonance Imaging (GluCEST) Detects Effects of Transcranial Magnetic Stimulation to the Motor Cortex

Published in *NeuroImage*, brainSTIM researchers Brian Erickson, Olu Faseyitan, Branch Coslett, Roy Hamilton, John Medaglia, along with Penn Radiology researchers, reported the results of a study investigating the mechanism by which transcranial magnetic stimulation (TMS) influences the brain and behavior. The study used a recently developed neuroimaging technique known as glutamate-weighted chemical exchange saturation transfer (gluCEST) in 7T magnetic field. The study assessed glutamatergic changes in motor cortex (M1) following an inhibitory form of stimulation called continuous theta burst stimulation (cTBS). Using gluCEST imaging, the authors were able to detect as much as a 5% decrease in median gluCEST in stimulated M1 tissues. The results of this study provide *in vivo* evidence that cTBS indeed produces long-term depression-like effects through the reduction of glutamate, a result previously undetected by other magnetic resonance spectroscopic techniques.

## Cortical-Subcortical Structural Connections Support Transcranial Magnetic Stimulation Engagement of the Amygdala

Drs. Yvette Sheline, Nicholas Balderston, Dani Bassett, Theodore Satterthwaite, and Desmond Oathes published in *Science Advances* research into use of transcranial magnetic stimulation (TMS) to exert neuromodulatory effects on the amygdala through cortical-subcortical connections. Previous TMS and combined functional neuroimaging (fMRI) had shown stimulating areas within prefrontal cortex (PFC) can evoke downstream changes in BOLD signal in the subgenual anterior cingulate cortex and the amygdala. The results of this study found that stimulation applied near ventral lateral PFC (vlPFC) elicited an acute functional response that was measurable in the amygdala. The authors highlighted aberrant activity of the amygdala and vlPFC has been linked to mood, anxiety, stress disorders, and psychopathology and the possibility of using the vlPFC–amygdala circuits as a candidate treatment for transdiagnostic psychopathological symptoms.

# Media

The New York Times

**"Pulses to Their Brains and Two Women's Binge Eating Went Away"**

Dr. Casey Halpern was featured in The New York Times for his pilot study on using deep brain stimulation to treat binge eating disorder.

Read the Full Story

CBS PHILADELPHIA

**"Brain Implant for Seizures Could Help Control Binge Eating"**

Dr. Casey Halpern was interviewed by CBS NEWS Philadelphia about his clinical trial that uses deep brain stimulation to stop binge eating disorder cravings. Dr. Daniel Barbosa's brain images are featured in the media piece to showcase the brain implant at work.

Pesquisa FAPESP

**"Changes in Brain Connections May Favor Weight Gain"**

Dr. Daniel Barbosa was interviewed by the Pequisa FAPESP magazine and podcast, one of the largest state-funding institutes in Brazil, about his work on Dr. Halpern's clinical trial on binge eating.

# Media

## Bloomberg

**"How Neuroscientists Use Brain Breaks to Boost Creativity"**

Dr. Michael Platt was interviewed by Bloomberg News for an article about manipulating neuroscience to boost your own creativity.

**"Take time for yourself. Many of us don't do enough of that."**
***- Dr. Michael Platt for Bloomberg***


**"Using Magnetic Fields to Treat Depression"**

Dr. Roy Hamilton explains how both TMS and tDCS work as tools for neural rehabilitation on The Franklin Institute podcast *So Curious!*. He also describes how neuromodulation experts are starting to investigate how brain stimulation can be tailored to each individual.

Read the Full Story

**"Maybe different people should be getting stimulated in somewhat different ways."**
***- Dr. Roy Hamilton for So Curious!***

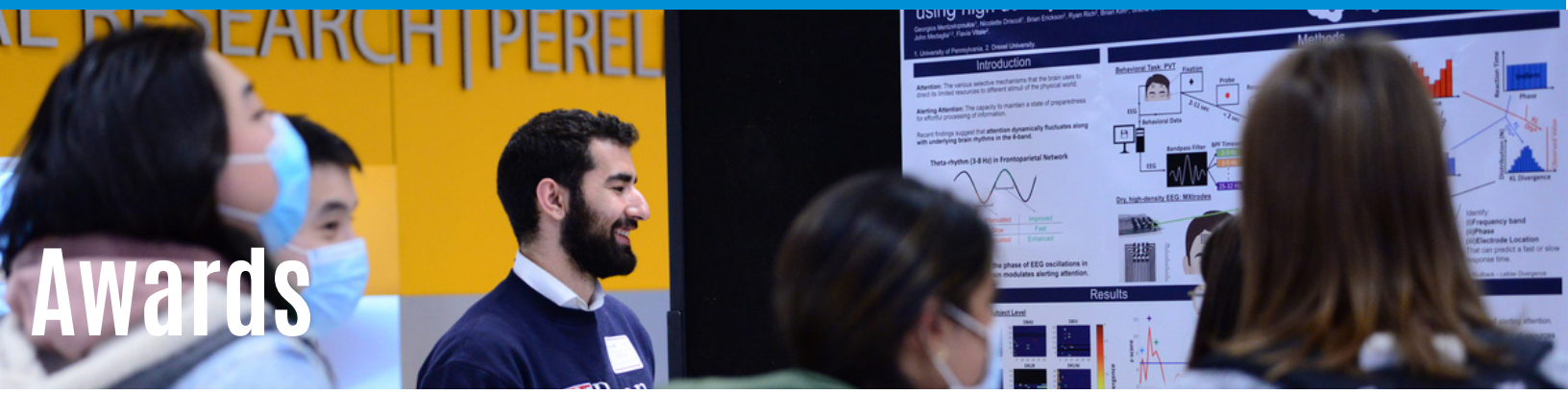
# Awards

## Roy Hamilton awarded the Science Diversity Leadership Award from the Chan Zuckerberg Initiative

Dr. Roy Hamilton is an awardee of the Chan Zuckerberg Initiative (CZI) Science Diversity Leadership Award. CZI partnered with the National Academies of Sciences, Engineering, and Medicine to launch the Science Diversity Leadership program, a funding opportunity aimed to recognize and further the leadership of excellent biomedical researchers who have a record of promoting diversity, equity and inclusion in their scientific fields. This was to recognize and further the work of scientists with a record of promoting science diversity work through their outreach, mentoring, teaching, and leadership, This funding will support Dr. Hamilton's work "Stimulating Brain Networks for Language and Building Networks in the Black Community to Fight Aphasia."


## John Medaglia received the Provost's Award for Outstanding Early-Career Scholarly Achievement Drexel University

Dr. John Medaglia was one of two pre-tenure faculty members to receive this university-wide commendation awarded to individuals "who have demonstrated unusual excellence in their scholarly field and who are considered emerging leaders in these fields."




## Kelly Sloane delivers keynote address at the 21st Annual John Scholz Stroke Education Conference

Dr. Kelly Sloane was selected to deliver a keynote address entitled "Innovative Approaches to Stroke Recovery" at the 2022 Scholz Stroke Education Conference hosted by the Delaware Academy of Medicine.


## Flavia Vitale awarded Innovative Application Award

Dr. Flavia Vitale received the Innovative Application Award at the joint Neuroergonomics Conference and NYC Neuromodulation Conference in July 2022.

# Looking to 2023 & Beyond

In 2023, we look forward to continued growth as an organization, greater innovation, and richer collaboration between brainSTIM investigators.

We are excited to continue our ongoing clinical trials for disorders like depression, attention deficit hyperactivity disorder (ADHD), obsessive compulsive disorder (OCD), binge eating, chronic stroke, and Alzheimer's disease. New federally funded and industry sponsored clinical trials that focus on diagnostic and therapeutic approaches in disorders such as acute stroke, epilepsy, and neurodegenerative aphasia (language loss) are anticipated in the coming year.

Our talented faculty and scientists continue to develop outstanding research, building on the initial support of the Perelman School of Medicine through numerous grants and awards, and through generous philanthropic gifts to brainSTIM investigators. The Hart Fund, in particular, will continue to help our center spearhead novel neuromodulation approaches.

In addition, in 2023 brainSTIM faculty aim to launch a robust training course in transcranial magnetic stimulation (TMS), featuring lectures and workshops led by our multidisciplinary team of outstanding brainSTIM faculty.

In short, with its superb team of scientists and clinicians, its impactful future projects, and its committed collaborators and intellectual stakeholders, the future of brainSTIM is once again bright. We look forward to working with all of you in the new year and what we hope will be many years to come.

# Giving Opportunities

Courtesy of Franklin Institute

We all have a stake in preserving and optimizing our brains' remarkable abilities. Thanks to your generous support, brainSTIM makes great progress toward groundbreaking discoveries in neuroscience. These discoveries allow us to develop new treatments for a wide range of neurologic and psychiatric disorders, and to find new ways to revitalize the performance of the human brain throughout the lifespan.

Every day, our globally renowned experts and scientific pioneers make breakthrough discoveries involving neuromodulation into novel treatments for brain disorders. Scientists and clinicians at brainSTIM focus on understanding the complex organization of the brain and harnessing its ability to reorganize in the setting of disease. Armed with this knowledge, we aim to stimulate the brain to undo the symptoms of the most common, debilitating disorders, including depression, anxiety, stroke, and dementia. With faculty whose work spans the fields of neurology, psychiatry, neurosurgery, neurorehabilitation, biomedical engineering, psychology, cognitive neuroscience, and animal research, brainSTIM is a cross-cutting network ideally situated to foster research collaboration across Penn and other institutions around the globe.

Your support will make a positive impact, both in the field of neuroscience and in the lives of patients and their families. Donor support for the brainSTIM Center supports our core efforts in three ways. First, philanthropy is critical to recruiting and retaining the most qualified clinical and translational scientists at the brainSTIM Center. Second, generous giving also supports promising research projects, including seed funding for highly innovative, early-stage research. Finally, philanthropic giving allows the brainSTIM Center to nurture the next generation of translational scientists (PhDs and MDs), who will advance scientific discoveries and develop advanced treatments for brain disorders using neuromodulation. Donors like you help us make discoveries that will reverse the burden of degenerative disorders, and with your support today, we can keep that momentum going.

Your philanthropic dollars make a world of difference in neuromodulation, and we are extremely grateful for your partnership. For additional information, or to donate to the Center, please visit the brainSTIM Giving Page, or the 'Donate' section of the brainSTIM website.

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