Dear brainSTIM family,

While our initial collective hope that 2021 would represent a dramatic improvement compared to the tumult of 2020, it's safe to say that last year offered its own formidable challenges. We continue to battle a global pandemic. Initially buoyed by the introduction of effective vaccines, the story of our return to normalcy has been complicated by setbacks in recent months. Yet, despite this and other hardships, I'm pleased to report that the Penn Brain Science, Translation, Innovation, and Modulation Center (brainSTIM) not only survived its second year, but thrived. Once again, I want to thank all of the faculty, staff, and supporters who have contributed to brainSTIM's ongoing success, and I'm excited to share our progress with you in this report.

BrainSTIM draws together the University of Pennsylvania's most well-established experts and rising pioneers in the science of neuromodulation. The work of brainSTIM faculty spans the fields of neurology, psychiatry, neurosurgery, neurorehabilitation, biomedical engineering, psychology, cognitive neuroscience, animal research, and others, to create an outstanding platform for multidisciplinary work in translational neuromodulation. As you will read in the pages that follow, brainSTIM faculty have continued to make tremendous scientific strides, employing neuromodulation as a tool for both characterizing the dynamic, complex nature of the brain and as a potential treatment for a range of psychiatric, neurologic and other medical conditions.

Over the course of 2021, brainSTIM continued to enjoy growth as an organization, as we welcomed additional members of the Penn community into our ranks. We are very excited by the recent arrival of Dr. Casey Halpern, a neurosurgeon-scientist doing groundbreaking research that combines invasive and noninvasive neuromodulation techniques. Last year we were also delighted to welcome a number of outstanding cognitive neuroscientists and clinician-scientists as center affiliates. In addition to expanding its presence at Penn, brainSTIM has made itself known far beyond the walls of the University. During the 2021-2022 academic year, in partnership with the Mahoney Institute for Neurosciences (MINS), brainSTIM has been hosting the MINS/brainSTIM Year of Neuromodulation. This year-long celebration of the science of neuromodulation has featured invited lectures from national and international luminaries in the field, and has provided a platform both for promoting cutting-edge scientific innovations and for introducing the broader neuromodulation community to the wealth of talent and innovation here at Penn.

BrainSTIM has a lot to look forward to in 2022. We continue to develop an outstanding research innovations, building on the initial support of the Perelman School of Medicine through numerous new grants and awards, and through recent, generous philanthropic gifts to brainSTIM investigators. We are developing a robust curriculum as we anticipate bringing on the next generation of neuromodulation-focused trainees in the coming academic year. There are several exciting clinical trials on the horizon, and we continue to work toward the development of truly multidisciplinary translational and clinical research operations involving neuromodulation at Penn. Additionally, the MINS/brainSTIM Year of Neuromodulation will culminate in the late spring with a symposium that will include some of the world's most highly recognized experts in the field. This is an exciting time for brainSTIM!

In closing, I again want to thank all of those 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 2022!

Roy Hamilton, MD, MS
Director, Penn Center for Brain Science, Translation, Innovation, and Modulation (brainSTIM)
Recent Changes to brainSTIM

Drawing together and supporting eminent and aspiring faculty from a wide range of fields is the key to achieving brainSTIM’s mission of advancing innovative, multidisciplinary scientific discoveries in the field of neuromodulation.

Welcome to brainSTIM!

Now entering its second year, the brainSTIM Center is proud to have expanded its core group of exceptional faculty, who are engaged in groundbreaking research and clinical work involving neuromodulation. In 2021, we were particularly excited that Neurosurgery joined Neurology, Psychology, and Physical Medicine & Rehabilitation on the growing list of clinically-relevant neuroscientific fields represented within brainSTIM. BrainSTIM membership also includes investigators in the Penn School of Arts & Sciences, School of Engineering, and the Wharton School. Thus, our faculty comprises a cross-cutting network of neuromodulation scientists ideally situated to foster research collaboration across the University of Pennsylvania and other institutions around the globe. Our core group of faculty continues to be joined by rising stars in neuromodulation research at Penn, as well as by outstanding collaborators who have partnered with us to make novel discoveries using neuromodulation. Collectively, our work runs the gamut from theoretically-motivated investigations involving computational and animal models of brain function to clinically-focused trials that directly examine the efficacy of brain stimulation as a therapeutic intervention. In the following section, we will introduce you to the new members of the Penn brainSTIM Center, and highlight some of the important work done this past year by our faculty and partner laboratories.
New Member of Faculty Steering Committee

Russell Epstein, PhD
Russell Epstein, PhD, is a Professor of Psychology at the University of Pennsylvania. Dr. Epstein directs the University of Pennsylvania’s Epstein Lab, where he leads a team in studying both perception, memory, and the neural mechanisms underlying visual scene perception, event perception, object recognition, and spatial navigation in humans.

Taneeta Mindy Ganguly, MD
Taneeta Mindy Ganguly, MD, is an Assistant Professor of Neurology at the University of Pennsylvania. She is also board certified in neurology and epilepsy, and a practicing physician at the Penn Epilepsy Center. She is a collaborating clinician for the Center for Neuroengineering and Therapeutics and a clinical trials fellow at the Institute for Translational Medicine and Therapeutics.

Martha J. Farah, PhD
Martha J. Farah, PhD, is a Walter H. Annenberg Professor of Natural Sciences and Professor of Psychology at the University of Pennsylvania, with secondary appointments in Neurology and the Graduate School of Education. Dr. Farah also directs the Center for Cognitive Neuroscience (CCN), as well as the Center for Neuroscience & Society (CNS). Dr. Farah is a cognitive neuroscientist with interests in the problems at the interface between neuroscience and society, which includes the effects of childhood poverty on brain development, the expanding use of neuropsychiatric medications by healthy people for brain enhancement, novel uses of brain imaging, e.g. legal diagnostic and educational contexts, and the many ways in which neuroscience is changing the way we think of ourselves as physical, mental, moral, and spiritual beings.

Emily Falk, PhD
Emily Falk, PhD, is a Professor of Communication, Psychology, and Marketing at the University of Pennsylvania. Dr. Falk directs Penn’s Communication Neuroscience Lab, and is a Distinguished Fellow of the Annenberg Public Policy Center. Dr. Falk’s research interests include behavioral change, persuasion, and how ideas and behaviors spread. She is an expert in the science of behavior change, and uses psychology, neuroscience, and communication to examine what makes messages persuasive, why and how ideas spread, and what makes people effective communicators.

Adrian Raine, PhD
Adrian Raine, PhD, is the Richard Perry University Professor of Criminology, Psychiatry, and Psychology at the University of Pennsylvania. His interdisciplinary research focuses on the etiology and prevention of antisocial, violent, and psychopathic behavior in children and adults, including biological interventions to reduce aggressive and antisocial behavior. His neuromodulation studies to date have focused on modulation of prefrontal cortical activity to reduce aggression and upregulate moral decision-making.

New Affiliated Center Scientists

Key collaborators with brainSTIM faculty

Casey H. Halpern, MD
Casey H. Halpern, MD, is an Associate Professor of Neurosurgery and Director of Stereotactic and Functional Neurosurgery at the University of Pennsylvania. Dr. Halpern’s clinical focus is in the treatment of movement disorders such as Parkinson’s, tremor, dystonia, and Tourette, as well as epilepsy and psychiatric disease. See Faculty Spotlight for more info on Dr. Halpern.

Taneeta Ganguly, MD
Taneeta Mindy Ganguly, MD, is an Assistant Professor of Neurology at the University of Pennsylvania. She is also board certified in neurology and epilepsy, and a practicing physician at the Penn Epilepsy Center. She is a collaborating clinician for the Center for Neuroengineering and Therapeutics and a clinical trials fellow at the Institute for Translational Medicine and Therapeutics.

Dr. Ganguly is interested in implementing clinical trials to expand the scope of diagnostic and therapeutic tools in the management of epilepsy. Her work primarily focuses on the use of devices in epilepsy, including transcranial electric stimulation, responsive neurostimulation, and continuous EEG monitoring.

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Internal Advisory Board
Leaders in neuroscience who guide brainSTIM

Murray Grossman, MD, EdD
• Professor of Neurology
• Founding Director, Penn Frontotemporal Degeneration Center (FTDC)

Frances Jensen, MD
• Arthur Knight Asbury, MD Professor of Neurology
• Chair of the Department of Neurology
• Co-Director, Penn Medicine Translational Neuroscience Center

John Detre, MD
• Professor of Neurology and Radiology
• Director, Brain Science Center
• Director, Center for Functional Neuroimaging
• Co-Director, Center for Magnetic Resonance and Spectroscopy

Raquel Gur, MD, PhD
• Karl and Linda Ricks Professor of Psychiatry
• Vice Chair for Research Development
• Director, Neuropsychiatry Section
• Co-Director, Penn Medicine Translational Neuroscience Center

Joseph Kable, PhD
• Baird Term Professor of Psychology
• Director, Center for Outreach, Research, and Education (mindCORE)

Brian Litt, MD
• Professor of Neurology, Neurosurgery, and Bioengineering
• Director, University of Pennsylvania Epilepsy Center
• Director, Center for Neuroengineering and Therapeutics (CNT)

Sharon Thompson-Schill, PhD
• Christopher H. Browne Distinguished Professor of Psychology
• Founding Director, Center for Outreach, Research, and Education (mindCORE)

David Wolk, MD
• Professor of Neurology
• Chief of the Cognitive Neurology Division
• Co-Director, Penn Memory Center
• Director, Penn Alzheimer’s Disease Research Center
• Co-Director, Institute of Aging

External Advisory Board
International luminaries in neuromodulation and technology who advise brainSTIM

Mitchell J. Blutt, MD
• Clinical Assistant Professor of Medicine, Weill Cornell Medicine Graduate School of Medical Sciences
• CEO, Consonance Capital

Michael D. Fox, MD, PhD
• Associate Professor of Neurology, Harvard Medical School
• Raymond D. Adams Distinguished Chair in Neurology
• Director, Center for Brain Circuit Therapeutics, Brigham & Women’s Hospital
• Kaye Family Research Director, Brain Stimulation Program
• Director, Laboratory for Brain Network Imaging and Modulation

Mark S. George, MD
• Distinguished Professor of Psychiatry, Radiology & Neuroscience, Medical University of South Carolina
• Founding Director, Center for Advanced Imaging Research
• Director, Brain Stimulation Laboratory, Psychiatry
• Layton McCurdy Endowed Chair in Psychiatry

Alvaro Pascual-Leone, MD, PhD
• Professor of Neurology, Harvard Medical School
• Medical Director, Deanna and Sidney Wool Center for Memory Health
• Senior Scientist, Hinda and Arthur Marcus Institute for Aging Research at Hebrew SeniorLife

Ana Maiques, MBA
• CEO, Neuroelectrics
• Co-Founder, Starlab
• EU Prize for Women Innovators from the European Commission EC Recipient (2014)
Chapter 2

The brainSTIM Center and Faculty have had many accomplishments in 2021. The brainSTIM Center was involved with philanthropy, were organizers of the Year of Neuromodulation, and the development of a neuromodulation training course. The faculty showed many successes this year including new funding and grants, high profile publications, and media appearances. Here are just a few of the highlights from 2021.
**2021 Center Highlights**

**Philanthropy**

*Creation of The Hart Fund in Cognitive Neuroscience*

**Acceleration of Neuromodulation Innovation Through Generous Giving**

One of the most exciting developments for the brainSTIM community in 2021 was the creation of The Hart Fund in Cognitive Neuroscience, which will serve to radically accelerate the scientific work of brainSTIM investigators, Desmond Oathes, PhD, and Roy Hamilton, MD, MS. Through the generous giving of Allison and Jed Hart, a total of $2.5M over the next six years will be used to accelerate innovations in noninvasive neuromodulation that will translate into improved treatments of psychiatric and neurologic patient populations.

As Co-Director of Penn’s brainSTIM Center and Associate Director of Penn’s Center for Neuromodulation in Depression and Stress (CNDSS), Dr. Oathes is leveraging cutting edge neuroimaging methods to generate novel, individualized, brain-based treatments for psychiatric disorders such as depression, anxiety, and PTSD, as well as enhancing complex cognitive functions including working memory and decision making. With the support of the Hart Fund, using functional MRI (fMRI), Dr. Oathes and his team have proposed to use deep learning (a form of machine learning/artificial intelligence) to define individual brain stimulation targets that fit known anxiety/depression brain patterns (decoding). These targets would then be carried into a combined transcranial magnetic stimulation (TMS) and fMRI session in which TMS frequency adjustments will be made for each patient in real time to determine an optimal stimulation protocol to mitigate patient negative thought patterns. These strategies would bring precision medicine to treatment for psychiatric disorders—bringing a level of individualized care that has never been achieved before.

As Director of the brainSTIM Center and the Laboratory for Cognition and Neural Stimulation (LCNS), Dr. Hamilton employs noninvasive brain stimulation to enhance a variety of human cognitive abilities in order to develop badly needed rehabilitative interventions for patients with cognitive deficits due to neurologic disease. Recently, Dr. Hamilton and his collaborators, including brainSTIM members John Medaglia, PhD, Denise Harvey, PhD, and Danielle Bassett, PhD, have demonstrated that it is possible to apply network neuroscience principles borrowed from neuroengineering to characterize individual differences in the structural connectivity of key language regions like Broca’s area. These individual network differences influence how TMS applied to the language system influences language performance. They are currently exploring whether these same network features in the reorganized language networks of persons with post-stroke aphasia similarly determine the effects of TMS. Through the support of the Hart Fund, Dr. Hamilton’s team aims to elucidate whether personal individual anatomical networks can be used to determine which brain area is the best TMS target for each individual living with stroke and post-stroke aphasia, allowing for the delivery of optimized, personalized neuromodulation in persons living with this common and often debilitating condition.

Taken together, support from the Hart Fund will enable these brainSTIM investigators to develop next-generation precision medicine approaches for determining where we should stimulate each patient and how we should stimulate those sites to achieve the best results. In addition to their individual projects, support from the Hart Fund will provide further opportunities for these brainSTIM investigators to collaborate and work synergistically to develop research projects along their many shared interests.

**Year of Neuromodulation**

In the 2021-2022 academic year, brainSTIM has been partnering with the Mahoney Institute for Neurosciences (MINS) to host the “MINS/brainSTIM Year of Neuromodulation.” This year-long event provides an opportunity to engage global leaders in the field of neuromodulation as invited speakers, host symposia that highlight cutting-edge advances in brain stimulation, and to showcase the outstanding work being done at the University of Pennsylvania. The Year of Neuromodulation kicked off in September 2021 with a student-led virtual symposium highlighting a diverse range of work being done by trainees in the Philadelphia area in this burgeoning field. Another high point in the Year of Neuromodulation was the annual Flexner Lecture, one of Penn’s three highly prestigious eponymous lectureships in neuroscience. This year’s invited speaker, Sarah H. Lisanby, MD, was joined by National Institute of Mental Health (NIMH) Director, Dr. E. Louis Grady, during the “Adventures in Psychiatric Neuromodulation” special lecture.

In addition, throughout the year, brainSTIM and MINS have teamed up to host other luminaries and emerging leaders in the field of neuromodulation as lectures in two highly complementary seminar series. The MINS/brainSTIM Year of Neuromodulation will culminate in April with our spring symposium, where we will host the invited speakers for Penn’s two other major neuroscience lectureships: the Sprague Lecture, to be delivered by Warren M. Grill, PhD (Duke) and the Adler Lecture, to be delivered by Alvaro Pascual-Leone, MD, PhD (Harvard). At the symposium, we will also announce our “Rising Star Award” recipient. This exceptionally talented early career scientist will present their work at the symposium and will receive a $10,000 prize. The Year of Neuromodulation has been, and will continue to be, 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.

**Year of Neuromodulation Seminar Series**

**October 28, 2021**

Wynn Legon, PhD

Virgil Tech

**November 11, 2021**

Mike Fox, MD, PhD

Harvard University

**December 16, 2021**

Marom Bikson, PhD

City College of New York

**January 20, 2022**

Katherine Scangos, MD, PhD

University of California, San Francisco

**February 10, 2022**

Azadeh Yazdan-Shahmorad, PhD

University of Washington

**March 17, 2022**

Kim Butts Pauly, PhD

Stanford University

**March 23, 2022**

Zafiris J. Daskalakis, MD, PhD

UC San Diego Health

**May 18, 2022**

Christoph Zrenner, MD

University of Toronto

**Special Lectures**

**48th Annual Louis B. Flexner Lecture:**

Sarah H. Lisanby, MD, Director, Division of Translational Research

National Institute of Mental Health

“Adventures in Psychiatric Neuromodulation”

**Lectures at our April 2022 Symposium**

**Sprague Lecture:**

Warren M. Grill, PhD

Duke University

“Closed Loop Brain Stimulation”

**Adler Lecture:**

Alvaro Pascual-Leone, MD, PhD

Professor of Neurology and Director of the Berenson-Allen Center for Noninvasive Brain Stimulation

Hebrew Senior Life

“Promoting Brain Health and Addressing Brain-Related Disabilities”

**MINS/brainSTIM Year of Neuromodulation**

The MINS/brainSTIM Year of Neuromodulation will culminate in April with our spring symposium, where we will host the invited speakers for Penn’s two other major neuroscience lectureships: the Sprague Lecture, to be delivered by Warren M. Grill, PhD (Duke) and the Adler Lecture, to be delivered by Alvaro Pascual-Leone, MD, PhD (Harvard). At the symposium, we will also announce our “Rising Star Award” recipient. This exceptionally talented early career scientist will present their work at the symposium and will receive a $10,000 prize. The Year of Neuromodulation has been, and will continue to be, 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.

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University of Toronto
In recent years, researchers have made historic progress in the increase of understanding of the functional organization of the human brain. The brainSTIM Center is honored to have many affiliated laboratories and institutions who continue to strive everyday to make novel innovations in a variety of fields, including neuromodulation, bioengineering, and psychology.

In the following section, we would like to highlight some of our brainSTIM Center faculty members who have made significant achievements in their fields and laboratories, as well as the published studies and research efforts put forth by various members of our faculty over the course of the past year.
Faculty 2021 Highlights

The Center for Brain Science, Translation, Innovation, and Modulation draws together an eminent team of investigators and clinicians who apply their diverse skills and expertise to better understand the organization of the human brain, and to develop neuromodulation-based interventions for common, debilitating disorders of the brain. Here are just a few of the highlights from our faculty members for 2021.

Nick Balderston, PhD is an experimental psychologist focusing on anxiety and a Research Assistant Professor of Psychiatry at the University of Pennsylvania. He received the 2021 Klerman Prize for Exceptional Clinical Research from the Brain, & Behavior Research Foundation: https://www.bbrfoundation.org/sites/default/files/pdfs/2021-kf-program.pdf. He was also awarded the 2021 NARSAD Young Investigator Award for his project entitled: Examining the Effect of FPN Stimulation on Behavior Research Foundation.

Mario Cristancho, MD is the director of the Transcranial Magnetic Stimulation and Neuromodulation Program at Penn Medicine as well as the Medical Director of the Outpatient Psychiatry services. He was featured in Philly Voice in an article entitled “Lane Johnson shines a spotlight on anxiety disorders and the drugs used to treat them”. The article was a discussion of the Eagles star experience with withdrawal symptoms after stopping an SSRI.

Ted Satterthwaite, MD, an Assistant Professor in the Department of Psychiatry and an attending physician at the Hospital of the University of Pennsylvania has two new NIH R01s for personalized networks. One entitled “Personalized Functional Network Modeling to Characterize Cognitive Functions of Youth” and the other “Precision Mapping of Individualized Executive Networks in Youth”. In addition, Dr. Satterthwaite is the recipient of a NIH Merit Award and has published new scientific papers in the journals Neuron, Nature Methods, and Neuropsychopharmacology.

Flavia Vitale, PhD is Assistant Professor of Neurology and Physical Medicine & Rehabilitation at the University of Pennsylvania where she works on engineering new technologies related to neurological and neuromuscular disorders such as epilepsy, Parkinson’s, nerve injury, and chronic pain. Along with brainSTIM colleague John Medaglia, PhD, from Drexel, they were awarded a NIH R01 for the development of the next-generation of dry EEG using MXene electrodes (a two-dimensional transition metal carbide nanomaterial). Their work was also chosen to be the cover article for Science Tranlational Medicine’s September 2021 issue.

Desmond Oathes, PhD, Co-Director of BrainSTIM, became associate member at the American College of Neuropsychopharmacology. He is also recipient of the generous multi-year philanthropic gift given by Allison and Jed Hart for establishment of the Hart Fund for Cognitive Neuroscience (see p.11).

Michael Platt, PhD, Penn Integrates Knowledge (PIK) Professor, has had a successful grant writing season with a renewed R01 and R37 NIH grant for the study of social cognition and social behavior, a new R21 to study prefrontal cortex in primates, and an NSF grant in collaboration with his startup company Cogwear LLC. Additionally, the Wharton Neuroscience Initiative brought on 2 new corporate partners: Mars Inc. and Slalom Inc., and renewed partnerships with Amplio Inc., SBB Bank, and AIR Inc.

Yvette Sheline, MD, a Professor of Psychiatry, Radiology, and Neurology, and the Director of the Center for Neuromodulation in Depression and Stress (CNDS), has had another successfully year. Among her successes are the awarding of two new grants. One from the Basser Center Brain Research Fund for research on TMS treatment for bipolar disorder entitled “Intensive TMS for Rapid Relief of Bipolar Depression Symptoms.” The other is a NIH grant entitled “Reducing Neural Perseveration Through Closed Loop Real Time tMRI Neurofeedback to Alleviate Depressive Symptoms.”

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Kelly Sloane, MD is Assistant Professor of Neurology. Dr. Sloane recently launched a randomized controlled trial to evaluate the effectiveness of TDCS to augment cognitive therapy for subacute stroke patients called TRAINS (TDCS and Rehabilitation to Ameliorate Impairments in Neurocognition after Stroke). This study builds on prior work by LCNS to understand the effect of TDCS on cognitive performance. It is uniquely located within the acute inpatient neuromodulation service at HUP, allowing us to provide opportunities for patients to be involved in innovative neurorecovery research during their inpatient stay. She was also awarded the CTSA KL2 Mentored Career Development Award and the McCabe Award, both from the University of Pennsylvania. See Faculty Spotlight for more information on Dr. Sloane.

Denise Harvey, PhD, Research Assistant Professors of Neurology, did multiple conference presentations about her work in aphasia including at the Academy of Aphasia, American Neurological Association, and the Society for the Neurobiology of Language annual conferences. She is continuing her use of tACS to enhance language abilities in post-stroke aphasia. She is also furthering her training after being accepted and having completed in Jan 2022 a grant writing workshop (Training in Grantmanship for Rehabilitation Research [TGRR]).

2021 was an eventful year for Roy Hamilton, MD, MS, Director of BrainSTIM. His team published multiple papers (with more in the pipeline), examining the relationship between TMS measures of cortical excitability and different genotypes of brain-derived neurotrophic factor (BDNF) in healthy persons and in persons with stroke and aphasia. His team continues to explore the relationship between functional connectivity, network properties of the language system and response to TMS, publishing a second paper demonstrating that individual differences in these networks predict different responses to TMS after stimulation of Broca area. Excitingly, Dr. Hamilton’s research efforts will be further bolstered through the generous support of the Hart Fund for Cognitive Neuroscience (see p.11), made possible by a philanthropic pledge made in 2021. Dr. Hamilton also assumed new leadership roles in 2021, serving as the new President of the Society for Behavioral and Cognitive Neurology (SBiCN), a national organization for neurologists who focus on disorders of human cognition.

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Highlighted Publications

Flavia Vitale on Developing New Technologies to Solve the Mysteries of the Brain

Flavia Vitale was featured in both Penn Medicine News and Penn Today where she discussed her work that interfaces three disciplines: neurology, bioengineering, and physical medicine and rehabilitation. Dr. Vitale discusses her path to Penn and her grants that were recently awarded. “My main goal is to create tools that can help patients of the brain, and address the needs of clinicians,” she says.

A Novel Physiological Vital Sign for Anxiety

In an article published in the Proceedings of the National Academy of Sciences, Dr. Casey Halpern and colleagues report the results from work using deep brain stimulation (DBS) applied to the nucleus accumbens to attenuate binge eating. Comparing the efficacy of continuous DBS (cDBS) vs responsive DBS (rDBS) stimulation in a transgenic mouse model, the research team was able to show changes in GADPH signaling with both protocols led to a reduction in high-fat intake compared to controls but only rDBS had a more enduring effect. This work suggests the possible use of rDBS as a therapeutic intervention for overeating.

Causal Role of the Right Temporoparietal Junction in Selfishness Depends on the Social Partner

In an article published in the Journal of Social Cognitive and Affective Neuroscience, the authors examined the importance of the work to be done. More broadly, receiving support from BBRF has been instrumental in launching Nick Balderston, PhD, was recently awarded by the Brain & Behavior Research Foundation the the 2021 Klerman Prize for exceptional clinical research. “Winning the Klerman Prize is an incredible honor, and a reminder of the importance of the work we do,” he says.

AMERILIAZATION OF HEDONIC FEEDING

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Deep Brain Stimulation of the Ventral Capsule/Ventral Striatum for Treatment-Resistant Depression: A Decade of Clinical Follow-Up

Dr. Mario Cristofaro and colleagues recently published results from work investigating the efficacy of deep brain stimulation (DBS) as a treatment for treatment-resistant depression (TRD) in the Journal of Clinical Psychiatry. Following a cohort of 8 patients with ventral capsule/ventral striatum DBS enrolled in a trial for over a decade (2009 - 2020), the authors saw a 44.9% mean improvement in MADRS depression scale over the course of the trial. These results of this study demonstrate the potential for sustained improvement of depressive symptoms for TRD patients.

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AMERILIAZATION OF HEDONIC FEEDING

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Causal Role of the Right Temporoparietal Junction in Selfishness Depends on the Social Partner

In an article published in the Journal of Social Cognitive and Affective Neuroscience, the authors examined the importance of the work to be done. More broadly, receiving support from BBRF has been instrumental in launching Nick Balderston, PhD, was recently awarded by the Brain & Behavior Research Foundation the the 2021 Klerman Prize for exceptional clinical research. “Winning the Klerman Prize is an incredible honor, and a reminder of the importance of the work we do,” he says.

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The brainSTIM Center is made up of faculty that span departments, representing a variety of disciplines, all with interests in multiple types of neuromodulation. The next section highlights two brainSTIM scientists and gives an introduction to them as well as their research, both ongoing and upcoming.

First up is Casey Halpern, MD, a recent recruit to Penn and a new member of brainSTIM’s Faculty Steering Committee. You will read about Dr. Halpern’s work trying to bridge the gap between invasive and non-invasive neuromodulation. Second is Kelly Sloane, MD, and one of brainSTIM’s Center Scientists. You will read about her new clinical trials focusing on tDCS in stroke and cognitive impairment after TIA. Both profiles give insight into the exciting work being done by just two of our clinician-scientists within the brainSTIM Center.
**SPOTLIGHT ON CASEY HALPERN, MD: New arrival at Penn and new member of the brainSTIM Faculty Steering Committee**

Casey H. Halpern, MD, is an Associate Professor of Neuropsychology and Chief of Stereotactic and Functional Neurosurgery at the University of Pennsylvania. Dr. Halpern's clinical focus is in the treatment of movement disorders such as Parkinson’s, tremor, dystonia, and Tourette, as well as epilepsy and psychiatric disease. He has a particular research interest in preclinical studies and developing clinical trials to expand indications for deep brain stimulation and other novel neuromodulatory therapies. He is actively examining the role of targeting the reward circuitry of the brain with neuromodulation, too for the treatment of obsessive-compulsive disorder and addiction, studies that could lead to possible novel treatments for these extremely common disorders.

While Dr. Halpern's clinical focus is deep brain stimulation and other exciting neuromodulatory techniques for movement disorders, he is collaborating with colleagues in Neurology and Psychiatry to expand the indications of these novel therapies to mental health.

The aim of his lab is to translate experimental findings from mouse models and advanced neuroimaging in humans to trials of deep brain stimulation and focused ultrasound for new indications.

**What is your vision?**

My vision is that invasive studies can substantially inform strategies of non-invasive brain stimulation that can scale to these broad populations of patients. Moreover, non-invasive studies can also inform invasive strategies by optimizing target selection and testing for disease reversibility.

**What big projects are you working on here at Penn?**

The Halpern Lab is currently conducting 3 clinical trials of deep brain stimulation given preclinical evidence of efficacy for binge eating disorder, obsessive-compulsive disorder, and even sleep disorders.

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

Examining the ability of transcranial magnetic stimulation and other non-invasive brain stimulation to explore the characteristics and limits of functional plasticity in the intact and injured human brain, I cannot imagine a better collaborator to carry out these studies.

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**SPOTLIGHT ON KELLY SLOANE, MD: brainSTIM Center Scientist**

Kelly Sloane received her BA in Classics at the University of Pennsylvania. She received her MD from Johns Hopkins School of Medicine and went on to complete her residency in Neurology at Johns Hopkins Hospital. After residency, she earned fellowships in Vascular Neurology at Massachusetts General Hospital/B Brigham and Women’s Hospital as well as Neurorecovery at Mass General/Spaulding Rehabilitation Hospital.

**Interview with Dr. Sloane:**

I have always felt a strong affinity with the elderly and benefited from close relationships with my grandparents. I gravitated to volunteer opportunities that would allow me to work with the elderly. During college, I volunteered at the Penn Memory Center where I became interested in cognitive disorders. This experience — seeing the profound effect that neurological disorders, like dementia, can have not only on one’s sense of self but also others’ perception of oneself — motivated me to pursue a career in neurology.

During my neurology residency, I had the privilege of caring for stroke patients from the hyperacute stage (when they entered the emergency department) to their inpatient hospitalization and into their recovery. Many of these patients experienced cognitive impairments that affect their sense of self, relationships and quality of life, and just as in neurodegenerative diseases, there are few therapeutic options to improve cognition. Having been inspired from these clinical experiences, I sought to pursue subspecialty fellowship training in vascular neurology and brain injury medicine and to expand my knowledge of cognitive neuroscience.

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

What is one of your future research endeavors?

My work as a clinician, witnessing the resiliency and perseverance of my patients who have experienced the life-changing effects of stroke or other brain injury, has inspired my research focus and passion. As a clinician-scientist, my goal is to leverage our understanding of neurophysiology and cognitive network connectivity to develop cognitive rehabilitation interventions that optimize natural post-injury neuroplastic processes. In addition to neuromodulatory techniques like tDCS or TMS, I am interested in other innovative, technology-based approaches to rehabilitation like web or mobile application based interventions that improve affordability and accessibility.

Thoughts on collaborating with brainSTIM?

The Penn brainSTIM Center is composed of experts from multiple disciplines who are committed to interdisciplinary conversation, collaboration, and translation to clinical research. All the collaborators at brainSTIM value teamwork and supportiveness, and it is evidenced by the fruitful partnerships that have emerged at the Center.

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Looking to 2022 & Beyond

Even though the future is notoriously difficult to predict, we know that brainSTIM has a lot to look forward to in 2022 and beyond.

What Does the Future Hold?

Looking back at 2021, it is hard to imagine that one could have predicted many of the events that came to pass, including but not limited to the rise (and hopefully the fall) of the omicron variant to COVID-19. However, even during an undoubtedly challenging year, brainSTIM managed to follow through on many of its goals and milestones for 2021. In 2022, 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), chronic stroke, and dementia. We also anticipate new clinical trials that focus on diagnostic and therapeutic approaches in disorders such as acute stroke, epilepsy, and obsessive compulsive disorder (OCD). In the coming year, many brainSTIM researchers will focus on three specific scientific priorities. First, we will continue to develop individualized circuit- and network-guided neuromodulation interventions for neurologic and psychiatric disorders. Second, investigators will continue to develop real-time neuromodulation approaches that can lead to further personalization of neuromodulation approaches. Of note, our pursuit of research in these two specific areas will be greatly accelerated by generous support offered through the Hart Fund. Finally, brainSTIM will intensify its focus on the development of novel materials and tools that will propel the next generation of brain stimulation technologies.

We are particularly excited by the recent arrival of new brainSTIM core faculty member, Dr. Casey Halpern. As he establishes his lab and neurosurgical practice, we look forward to the development of collaborative interdisciplinary projects that use deep brain stimulation for conditions like OCD and obesity and which span the use of both invasive and noninvasive neuromodulation. Additionally, in July, brainSTIM will welcome its first neuromodulation-focused cognitive neurology fellow, Dr. Catherine Norise, who brings with her extensive prior experience on the use of tDCS in persons with post-stroke and neurodegenerative aphasias.

In addition to our excellent research and outstanding new investigators, we look forward to the culmination of our year-long MINS/brainSTIM Year of Neuromodulation in April, when we will host our much anticipated Spring Symposium. We also continue to work on the development of an excellent training course in transcranial magnetic stimulation (TMS), featuring lectures and workshops led by our multidisciplinary team of outstanding brainSTIM faculty.

In short, with its excellent 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.
We all have a stake in preserving and optimizing our brains’ remarkable abilities. Thanks to your generous support, the Penn Brain Science, Translation, Innovation, and Modulation Center (Penn brainSTIM Center) is making great progress toward groundbreaking discoveries in neuroscience. These discoveries allow us to develop novel treatments for a wide range of neurologic and psychiatric disorders and to find new ways to revitalize and enhance the performance of the human brain throughout the lifespan.

Every day, our globally renowned experts and scientific pioneers are turning innovative discoveries involving neuromodulation into novel treatments for brain disorders. Scientists and clinicians at the Penn brainSTIM Center are focused 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 in order to undo the symptoms of some of the most common, debilitating disorders of the brain, 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, the brainSTIM Center 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 novel 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 advancing research and clinical innovations 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.

"We all have a stake in preserving and optimizing our brains’ remarkable abilities."