

Brain Stimulation and Therapeutic Modulation Division

July 1, 2006 – June 30, 2007

1. Highlights

- 1) Brain Stimulation and Therapeutic Modulation was elevated to Division status on November 1, 2006.
- 2) Dr. Alexandra Sporn received a K12 Award (co-mentors: SH Lisanby and B Peterson): “Neurocircuitry of Autism Spectrum Disorders: fMRI and TMS studies”
- 3) Dr. Angel Peterchev received a grant from the National Institute of Biomedical Imaging and Bioengineering (NIBIB) to develop a novel TMS device with controllable pulse shape: “Development of A Novel TMS Device with Controllable Pulse Shape”
- 4) Dr. Joan Prudic was named a New York State Office of Mental Health Policy Scholar for her project: “Electroconvulsive Therapy in Chronically Psychotic Patients: Towards Evidence Based Treatment”
- 5) Dr. Sarah H. Lisanby published a Clinical Therapeutics feature on Electroconvulsive Therapy in the *New England Journal of Medicine*.
- 6) Dr. Bruce Luber published in *Cerebral Cortex* the first report that fMRI-guided TMS could partially remediate working memory deficits induced by sleep deprivation, testing the functional role of neural reserve networks.
- 7) Dr. Arielle Stanford received a CTSA Pilot Award from the Irving Institute for Clinical and Translational Research (ICTR) and Clinical Trials Office, entitled “Delineating and modulating the circuitry of volition: Treatment development in Schizophrenia”
- 8) The Division received four NARSAD Young Investigator Awards to Drs. Peter Bulow, Antonio Mantovani, Jason Scalia, and Alexandra Sporn.
- 9) Columbia filed a patent for novel technology developed in the Division: Peterchev, A. V. (2007). Systems and Methods for Inducing Electric Field Pulses in a Body Organ. U.S. Patent Application. Assignee: Columbia University.

2. Staff

Sarah H. Lisanby, MD - Division Chief, Research Psychiatrist II
Fortunato Battaglia, MD, PhD - Visiting Assistant Professor of Psychiatry
Julien Besle, PhD - Postdoctoral Research Fellow
Peter Bulow, MD - Postdoctoral Clinical Research Fellow
Chi-Ming Chen, PhD - Postdoctoral Research Scientist
Yael Cycowicz, PhD - Associate Research Scientist
Zhi De Deng - Graduate Student, Electrical Engineering and Psychiatry
Linda Fitzsimmons, MS, RNC- Nurse
Reza Jalinous, PhD - Adjunct Assistant Professor of Neuroscience (in Psychiatry)
Alleyama Karyat, RN - Nurse
Bruce Luber, PhD - Instructor of Psychology (in Psychiatry)
Antonio Mantovani, MD, PhD - Postdoctoral Clinical Research Fellow
Shawn McClintock, PhD - Postdoctoral Research Fellow
Janet Mindes, PhD - Education Director
Angel Peterchev, PhD - Instructor in Clinical Psychiatry
Jason Scalia, PhD - Instructor of Clinical Neuroscience (in Psychiatry)
Joan Prudic, MD - Research Psychiatrist II, Associate Professor of Clinical Psychiatry
Stefan Rowny, MD - Postdoctoral Clinical Research Fellow
Charles Schroeder, PhD - Research Scientist 6, Professor of Clinical Neuroscience (in Psychiatry)
Alexandra Sporn, MD - Assistant Professor of Clinical Psychiatry

Arielle Stanford, MD	- Assistant Professor of Clinical Psychiatry
Herbert Terrace, PhD	- Professor of Psychology in Psychiatry
S. Robert Vorel, MD, PhD	- Postdoctoral Clinical Research Fellow

3. Overview

The Brain Stimulation and Therapeutic Modulation (BSTM) Division specializes in the use of emerging electromagnetic means of modulating brain function to study and treat psychiatric disorders. The ability to stimulate targeted brain structures noninvasively has opened for the first time the potential to probe the circuitry underlying brain-based disorders and represents a powerful new tool for treating disorders that fail to respond to conventional therapies.

The BSTM encompasses research programs (preclinical, translational, and clinical) and clinical services utilizing existing and emerging brain stimulation and neuromodulation interventions at NYSPI and NYPH. These techniques include deep brain stimulation (DBS), electroconvulsive therapy (ECT), magnetic seizure therapy (MST), transcranial direct current stimulation (tDCS), transcranial magnetic stimulation (TMS), and vagus nerve stimulation (VNS). These techniques are applied as probes of brain function, as therapeutic interventions, or in conjunction with functional imaging (simultaneous TMS/fMRI, TMS/PET, TMS/MRS).

The clinical research facilities include the Brain Behavior Clinic at NYSPI, the Brain Stimulation Service at NYPH, 2 human TMS treatment suites at NYSPI, the TMS Unit of the fMRI Center, Stimulation/Imaging facilities (TMS/fMRI, TMS/PET, TMS/MRS), and the ECT suites at NYSPI and NYPH.

The preclinical research facilities include the Nonhuman Primate Brain Stimulation Lab, the Primate Cognition Lab, and the Brain Stimulation Technology Development Laboratory specializing in novel device design and implementation.

The BSTM pulls together expertise in the neuroanatomical, cognitive, and neurophysiological assessment of the impact of stimulation on brain function in the nonhuman primate model and in the clinical setting. Close collaborations with the Molecular Imaging and Neuropathology Division (Drs. Arango, Dwork, Underwood) provide the platform for neuroanatomical and neuropathological studies on the impact of brain stimulation on hippocampal plasticity (including neurogenesis, synaptic remodeling, and gene expression). The Primate Cognition Laboratory (Dr. Terrace) provides custom neurocognitive batteries to assess the impact of brain stimulation on a rich variety of cognitive functions in monkeys (including anterograde and retrograde amnesia, working memory, spatial memory, serial list learning, ordinal position, numerosity, and meta-cognition). The Nonhuman Primate Brain Stimulation Lab, coupled with the physiological expertise of Dr. Charles Schroeder, performs intracerebral recordings of the neurophysiological effects of brain stimulation.

Finally, our Technology Development Laboratory enables us to design, model, construct, and test novel devices for brain stimulation that are purpose-built to match the physiology of the human brain. The objective of the Technology Development Lab is to enhance the functionality of brain stimulation devices using novel technological solutions informed by the neurophysiology and neurodynamics of the human brain. New technologies could enable researchers and clinicians to optimize brain stimulation paradigms for basic science and therapeutic applications. In line with these goals, the Lab carries out design and implementation of novel electromagnetic brain stimulation devices, modeling of the electric and magnetic fields induced in the brain during stimulation, as well as basic research studies on the effect of various stimulation parameters on the subjects' physiological response.

4. Current Research

Active research in the BSTM ranges from basic neuroscience studies on brain behavior

relationships, to novel intervention development, to clinical trials. Recent work with electroconvulsive therapy, magnetic seizure therapy, transcranial magnetic stimulation, transcranial direct current stimulation, vagus nerve stimulation, and brain stimulation technology development is summarized below.

Electroconvulsive Therapy (ECT): Continuing the NYSPI tradition of excellence in ECT research, Dr. Lisanby serves as co-PI on a multi-institutional collaborative grant submission on post-ECT relapse prevention entitled “Prolonging remission in depressed elderly.” This project will test the first algorithm-based system for timing maintenance ECT sessions, and will examine neurobiological indices associated with unstable remission in depressed elderly. This project takes optimal advantage of the Columbia-Cornell ECT system, and expertise at Cornell in neuroimaging markers of unstable remission in geriatric depression (Drs. George Alexopoulos and Robert Young). Dr. Joan Prudic, Medical Director of ECT at NYSPI and NYPI, serves as the PI of the Columbia clinical site. Dr. Prudic has launched a new study in collaboration with Dr. Alice Medalia, examining for the first time the impact of cognitive remediation on post-ECT amnesia. Dr. Prudic was selected as an OMH Policy Research Scholar, for her proposal entitled “Electroconvulsive Therapy in Chronically Psychotic Patients: Towards Evidence Based Treatment.” The goal of this project is to improve the quality of ECT care in the OMH system.

Magnetic Seizure Therapy (MST): A focus of our work is on the development of MST as a less invasive means of performing convulsive therapy. Our results demonstrate that MST can induce seizures from focal regions of the cortex that have less involvement of deeper brain structures (such as medial temporal cortex) that are implicated in the amnestic side effects of ECT. Parallel studies in a preclinical model (R01 MH60884, PI: Lisanby) and in patients with depression (supported by grants to Dr. Lisanby from NARSAD, Stanley Foundation, and American Federation for Aging Research) are testing its feasibility and safety. Results include the first publications on the safety of MST (and ECT) in a preclinical model, the finding that MST has a better acute safety profile than ECT in patients with depression, neurophysiological evidence that MST-induced seizure are more focal and result in relative sparing of deeper brain structures compared to ECT, and a publication on the anesthetic considerations for MST.

We also found that ECT significantly induces the proliferation of new cells and aberrant sprouting of mossy fibers in the dentate gyrus in a preclinical model. These results have implications for the mechanisms of action of convulsive therapy, and for antidepressant pathways in general.

We completed the first trial of the antidepressant efficacy of MST in patients with major depression. We are now engaged in a Stanley supported two-center trial of MST in the US, and launched an international cooperative trial with sites in Wales and Scotland (supported by the Medical Research Council Brain Sciences II) using a novel MST device design capable of higher output than the original device. The first human to receive 100 Hz MST was treated as part of this international collaboration. We submitted our report on the first eleven cases receiving 100 Hz MST, demonstrating exceptionally fast recovery of orientation after high dose MST. We also reported in *Biological Psychiatry* superior cognitive outcomes following chronic treatment with high dose MST compared with ECS in nonhuman primates. The human and monkey cognition studies were selected for presentation at the 2007 American College of Neuropsychopharmacology Hot Topics session, presented by Dr. Lisanby.

We recruited Dr. Stefan Rowny who has joined the Division as a Postdoctoral fellow to develop work with functional neuroimaging to study the neurobiological effects of MST. We also recruited Dr. Shawn McClintock, a postdoctoral fellow co-mentored by Dr. Lisanby and Dr. Mustafa Husain at UTSW who is developing translational studies on the cognitive effects of MST in monkeys and depressed patients. Finally, we recruited Dr. Yael Cycowicz who has applied her expertise in neurophysiology to the study of MST induced seizures, completing and publishing novel findings on how these seizures differ from ECT, and the potential relevance of those differences to clinical outcome.

Transcranial Magnetic Stimulation (TMS): Our work with subconvulsive levels of TMS encompasses basic studies using TMS in conjunction with functional imaging as a mapping tool, and clinical trials in the treatment of depression and other disorders. Our basic work with TMS includes active studies on working memory, classical conditioning, deception, visual masking, self-awareness, and

language processing. One of our basic cognitive neuroscience projects funded by DARPA (co-PIs: Lisanby and Stern) utilizes fMRI and TMS in the study of the effects of sleep deprivation on working memory circuits. This work has isolated brain networks expressed during task performance, affected by sleep deprivation, and differentially affected as a function of cognitive susceptibility to sleep deprivation. We published our results that TMS stereotaxically applied to nodes in these networks facilitates working memory performance in a frequency- and time-dependent fashion, work led by Dr. Bruce Luber. We further published our finding that TMS was able to remediate the effects of sleep deprivation on working memory in *Cerebral Cortex*.

In other projects supported by DARPA, we published the first demonstration of classical conditioned learning using TMS, a novel result important for the interpretation of behavioral and clinical effects seen with TMS. We also completed a study providing the first demonstration that TMS could slow performance on a deception task in a site and latency dependent fashion, a result important to understanding neural circuitry involved in deceptive processes. We continue work on an additional DARPA sponsored project to enhance the restorative properties of sleep using TMS-induced slow wave oscillations. Dr. Arielle Stanford received a new CTSA pilot award to use fMRI and TMS to delineate and modulate the circuitry involved in volition, a study that lays the foundation for future work on the pathophysiology of avolition in schizophrenia.

This year we expanded our collaborations with other departments interested in using TMS to study basic brain processes. John Ferrera completed his dissertation project in neuropsychology, co-mentored by Drs. Joy Hirsch and Sarah Lisanby, using fMRI-guided rTMS as a probe of language processing. This work discovered for the first time a functional dissociation between dorsal and ventral regions of Wernicke's area, and demonstrated the utility of fMRI-guided TMS in determination of hemispheric language dominance. Other collaborations underway with the Columbia Psychology Department and the Columbia Business School include work on the neural basis of intertemporal discounting with Drs. Bernd Figner, Eric Johnson, and Elke Weber.

Our clinical work with TMS includes active trials in depression (Dr. Lisanby, R01 MH069895), schizophrenia (Dr. Arielle Stanford, K23 MH076976, NARSAD), OCD (Drs. Antonio Mantovani, Blair Simpson, and Brian Fallon), depersonalization disorder (Drs. Mantovani and Dr. Simeon of Mount Sinai, Frontier Fund), Tourette's Disorder (Drs. Mantovani and James Leckman, TSA grant and R21 MH082323), co-morbid panic disorder and depression (Dr. Mantovani, NARSAD), and autism (Dr. Alexandra Sporn, supported by a K12, Autism Speaks, and a private donor). The results of the industry-sponsored (Neuronetics, Columbia PI: Lisanby) pivotal multicenter trial of TMS in the treatment of depression were published and are currently under review by the FDA. We are midway through a similar NIMH sponsored 4-center trial of TMS for depression (R01 MH069895). We have taken the opportunity to spearhead some add-ons to this trial, examining genetic polymorphisms relevant to treatment response and fMRI and DTI measures of prefrontal cortex function before and after the course of rTMS treatment (led by Dr. Alexandra Sporn, and supported by NARSAD). We also received with Dr. George a NIDA supplement to study the impact of prefrontal rTMS on measures relevant to nicotine craving, in collaboration with Drs. Vorel and Bisaga of the Substance Abuse Division. We also have an active program with TMS in schizophrenia, led by Dr. Arielle Stanford. Dr. Stanford continues work on her NARSAD and NIMH K23 funded studies using rTMS in the study and treatment of the negative symptoms of schizophrenia. This work dovetails with the Dana supported collaborative grant with Drs. Larry Kegeles, Dikoma Shungu, Arielle Stanford, and SH Lisanby, to map abnormal excitatory and inhibitory neurochemical circuitry in schizophrenia with rTMS and MRS. That project should inform the selection of rTMS dosing to alter GABA/glutamate balance in schizophrenia, and will also serve as a probe of GABA/glutamatergic transmission in schizophrenic patients as compared with controls. This year we received new support from the Lieber Center to study the role of gamma oscillations and GABA in working memory deficits in schizophrenia, and recruited Dr. Chi-Ming Chen to lead our new work using TMS to study the functional role of oscillations. Finally, we launched the first studies employing TMS and tDCS (see below) in the study and treatment of autism spectrum disorders. Led by Dr. Sporn, and

supported by her K12 (co-mentors – Drs. Lisanby, Peterson, and Whitaker), Autism Speaks, and a private donor, studies are underway to examine the neural basis of social deficits and repetitive behaviors in this developmental disorder.

Transcranial direct current stimulation (tDCS): tDCS is a noninvasive means of altering endogenous firing rates of cortical neurons using polarization with weak direct currents applied to the scalp. Reports suggest tDCS may have antidepressant properties, and may enhance some forms of memory. We our work supported by DARPA (PI: Lisanby) to test the ability of tDCS to affect working memory. Dr. Peter Bulow’s NARSAD supported trial on the antidepressant properties of tDCS applied to prefrontal cortex is underway.

Vagus Nerve Stimulation (VNS): VNS was approved for the treatment of resistant major depression, but questions remain regarding patient selection and dose-response relationships. We continue work on two multicenter postmarketing trials to address some of these questions (Treatment Resistant Depression Registry and D21 Dose Finding Study, PI: Lisanby). We also received an investigator-initiated contract to study of the impact of VNS on TMS measures of cortical excitability in patients with treatment resistant depression (PIs: Mantovani and Lisanby).

Technology Development: Led by Dr. Peterchev, the Technology Development Laboratory has expanded with the recruitment of Dr. Reza Jalinous, one of the co-inventors of TMS and Technical Director at the Magstim Company, who was appointed Adjunct Associate Professor. Mr. Zhi-De Deng started Ph.D. thesis with Dr. Peterchev on the topic of TMS technology, the first student co-mentored by Engineering and Psychiatry Departments. The Technology Development Laboratory has made significant advances over the past year in three domains: controllable pulse shape TMS (cTMS), modeling of MST and ECT, and TMS/Imaging integration. cTMS: We have continued the development of a novel TMS device with controllable pulse parameters (cTMS). cTMS could enable research and clinical uses that have not been previously possible due to technological limitations, and could improve tolerability and efficacy in therapeutic applications. Dr. Peterchev received a two-year NIH R21 award to support this work. Columbia University submitted a patent application on the cTMS technology, and is in active negotiations with a number of device companies regarding licensing agreements. MST and ECT modeling: We are studying the relationship between the induced cerebral current intensity and the resulting seizure activity in electroconvulsive therapy (ECT) and magnetic seizure therapy (MST). We have demonstrated that, compared to ECT, MST generates weaker currents and ictal expression in central portions of the brain. This could account for the reduced cognitive side effects of MST that has been reported in nonhuman primates and depressed patients. This study has also suggested that ECT at current pulse amplitudes lower than those conventionally used could have a more targeted therapeutic effect with potentially less side effects. This work was presented at the annual American College of Neuropsychopharmacology meeting in December 2007. TMS – Imaging Integration: Imaging of brain activity during TMS or other forms of brain stimulation is central to understanding and optimizing research and clinical stimulation paradigms. We have made further progress in the installation of state-of-the-art systems that allow functional magnetic resonance imaging (fMRI) and electroencephalography (EEG) to be carried out simultaneously with TMS. TMS-fMRI integration has been supported by a DARPA grant with co-PI Dr. Lisanby, and a new TMS-EEG system was acquired with funding from a New York State Office of Science, Technology and Academic Research (NYSTAR) award to Dr. Lisanby.

Primate Cognition Laboratory: Led by Dr. Terrace and supported by R01s MH040462 (Terrace) and MH60884 (Lisanby), the primate cognition laboratory continues to innovate new paradigms to probe the impact of brain stimulation on various aspects of nonhuman primate cognition. This year we published in *Biological Psychiatry* the first study on the impact of a full course of high dose MST on cognition, finding that it had less of an effect than electroconvulsive shock (ECS), and presented these results at the ACNP Hot Topic session. Other major publications from Dr. Terrace’s lab this year focused on the transfer of metacognitive skills and hint seeking in monkeys (*Psychological Sciences*), cognitive imitation in children and monkeys (*Animal Cognition*), and the “generation effect” (*Psychological Sciences*).

Physiology: Dr. Charles Schroeder’s expertise in multichannel electrical recording in awake

primates, multisensory integration, and the functional significance of oscillations in information processing has been a productive addition to the Division. His addition has greatly enhanced our ongoing primate studies of the physiological impact of brain stimulation, and has enabled us to apply for new grant applications to guide brain stimulation dosing strategies to be optimally tuned to ongoing endogenous physiological properties. Dr. Schroeder is a co-investigator on the NYSTAR award that supports the development of EEG-synchronized TMS delivery, and our new Lieber Center projects on the functional role of gamma oscillations in cognition and schizophrenia. Dr. Schroeder's R01s are on the physiology of visual dysfunction in schizophrenia (MH060358), somato-auditory convergence (MH061989), and the neurophysiological basis of fMRI (MH067560). Dr. Schroeder recruited Dr. Julien Besle to the Division as a postdoctoral fellow, to further develop work in these areas.

Collaborations: The BSTM serves as a resource for other groups wishing to utilize brain stimulation techniques to investigate other research questions. We have active collaborations with the Sergievsky Center in Neurology with Dr. Yaakov Stern (DARPA), Barnard Psychology with Dr. Peter Balsam (DARPA), fMRI Center with Joy Hirsch, Hatch Center with Truman Brown (DARPA), Columbia Psychology (Drs. Tor Wager, Bernd Figner, Daria Knoch, Herbert Terrace), Brain Imaging with Drs. Larry Kegeles and Dikoma Shungu (Dana and Lieber Center funded TMS/MRS study) and Dr. Brad Peterson (K12 co-mentor for Dr. Sporn), the Anxiety Disorders Group (Drs. Fallon and Simpson), the Substance Abuse Division (Drs. Vorel and Bisaga), and the Center for Decision Sciences at the Columbia Business School (Drs. Elke Weber and Eric Johnson).

5. Education and Training

In the past year the BSTM has provided rotations to undergraduates, medical students, graduate students, residents, and visiting fellows from Columbia and other universities. We support postdoctoral fellowship lines on our DARPA grants. We are mentoring a graduate student on a TMS/fMRI language study (John Ferrera, co-mentors Drs. Hirsch and Lisanby). Zhi-De Deng joined the Technology Development Lab at the Division of Brain Stimulation and Therapeutic Modulation as a Ph.D. student advised by Dr. Peterchev. Mr. Deng is also affiliated with the Department of Electrical Engineering which provides an outstanding opportunity for interdisciplinary and interdepartmental collaboration. Mr. Deng is working on the development of novel coils for TMS, which could enable an improvement of therapeutic efficacy and blinding in clinical trials.

Janet Mindes, PhD, joined the Division this year as our Education Director, supported by a charitable gift from the Blum Foundation to institute a Brain Stimulation Education program. Dr. Mindes has created and organizes our very active brain stimulation informal speaker series and journal club, and has expanded and strengthened our educational programs. We continue to offer popular CME programs in TMS and ECT, which are provided free of charge to Columbia trainees and faculty. We instituted a Brain Stimulation Journal Club that has attracted internal and outside speakers and attendees from neurology and neurosurgery. Dr. Schroeder leads the Oscillations Journal Club that serves as a focus for researchers in Psychiatry, Neurology, and Neurosurgery using translational means to examine the functional role of oscillations in normal and disordered brain function.

6. Clinical Services

Brain Behavior Clinic (BBC): The BBC at NYSPI specializes in the evaluation and treatment of pharmacotherapy resistant disorders, including mood, anxiety, and psychotic disorders. We enroll patients into approved research protocols when appropriate, and provide post-protocol clinical care following study termination.

Brain Stimulation Service (BSS): The BSS at NYPH is a unique specialty program offering expert consultations, treatment, and research into innovations in therapeutic brain stimulation. The BSS is uniquely poised to transition new therapeutic devices into clinical application, given our translational

research program that ushers novel treatments from device development through pivotal multi-center clinical trials. As novel device-based therapies become FDA-approved, they are added to the spectrum of treatments offered in the BSS. The BSS represents a mutually beneficial bridge between NYPH and NYSPI, enhancing the quality of the clinical care, while increasing patient access to research protocols. The BSS provides management for outpatient ECT, enabling the ECT service to open on outpatient ECT program.

Electroconvulsive Therapy (ECT): The ECT services and NYSPI and NYPH provide state of the art clinical care to patients referred for ECT. The services also support approved research studies on novel forms of convulsive therapy. The opening of the outpatient ECT service greatly increased the ECT programs patient flow and revenues this year.

7. Awards and Honors

- 1) R21 EB006855-01 (PI: A Peterchev): Development of A Novel TMS Device with Controllable Pulse Shape (cTMS)
- 2) R21 MH082323 (PI: Leckman; PI of Columbia/NYSPI site: Lisanby): Transcranial magnetic stimulation for adults with severe Tourette Syndrome
- 3) K12 Award to Dr. Alexandra Sporn (co-mentors: SH Lisanby and B Peterson): “Neurocircuitry of Autism Spectrum Disorders: fMRI and TMS studies”
- 4) K23 MH076976 Award to Dr. Arielle Stanford (co-mentors: SH Lisanby and D Malaspina): “Negative symptoms of schizophrenia: From phenomenology to targeted treatment”
- 5) NY State Office of Science, Technology and Academic Research Faculty Development Award to Dr. SH Lisanby. Shaping The Future of Therapeutic Neuromodulation
- 6) DARPA grant: TMS-Enhanced ‘Power-Nap’: A practical system for inducing slow oscillations during sleep” (PI: Lisanby)
- 7) 2006 NARSAD Young Investigator Awards:
 - a. Peter Bulow, MD (mentor: SH Lisanby): Transcranial Direct Current Stimulation for the Treatment of Depression
- 8) 2007 NARSAD Young Investigator Awards:
 - a. Alexandra Sporn, MD (mentor: SH Lisanby): Genetic Predictors of Antidepressant Response to repetitive Transcranial Magnetic Stimulation (rTMS) in Treatment Resistant Depression
 - b. Antonio Mantovani, MD (mentor: SH Lisanby): rTMS in the treatment of panic disorder with comorbid major depression
 - c. Jason Scalia, PhD (co-mentors: Lisanby and Arango): The effects of convulsive therapies for depression on the neuronal organization of the hippocampus
- 9) Lieber Center: Working Memory Deficits: GABA to Gamma to Function (Drs. Lisanby, Stanford, Schroeder, and Kegeles).
- 10) Tourette Syndrome Association (coPIs Lisanby and Leckman): Transcranial magnetic stimulation for adults with severe Tourette Syndrome
- 11) Autism Speaks (PI: A Sporn): Transcranial magnetic stimulation (TMS) for the evaluation and treatment of repetitive behavior in subjects with autism spectrum disorders
- 12) CTSA Irving Institute for Clinical and Translational Research (PI: A Stanford): Neurocircuitry of Negative Symptoms of Schizophrenia: FMRI and TMS studies
- 13) Charitable gift from the Blum Foundation, to establish the Brain Stimulation Education Fund
- 14) Charitable gift from Peter Bucceri to develop brain stimulation research in autism
- 15) American College of Neuropsychopharmacology Young Investigator Memorial Travel Award to Dr. Peterchev
- 16) Patent filed: Peterchev, A. V. (2007). Systems and Methods for Inducing Electric Field Pulses in a Body Organ. U.S. Patent Application. Assignee: Columbia University. Filing date: 3/28/2007.
- 17) Frontier Fund Award (PI: A Peterchev): Real-Time Electroencephalographic Feedback Control of

Transcranial Magnetic Stimulation

18) Frontier Fund Award (PI: A Mantovani): Neural Circuitry of Depersonalization Disorder: A TMS Study

19) Promotion to Instructor of Clinical Psychiatry – Dr. Peterchev

8. Publications:

- Aaronson, S., Avery, D., Canterbury, R., Daskalakis, J., Gutierrez, M., Husain, M.M., Isenberg, K., Janicak, P., Krystal, A., Lisanby, S.H., Loo, C., Maixner, D., Marangell, L., McDonald, W., Nahas, Z., O'Reardon, J.P., Richelson, E., Rosenquist, P., Sackeim, H., Sampson, S., Solvason, H.B. Transcranial magnetic stimulation: effectiveness and safety in a randomized, controlled, multisite clinical trial and an open-label extension study. American College of Neuropsychopharmacology 2006 Annual Meeting, Neuropsychopharmacology. 31:S230.
- Anglin, D, Stanford, AD, Malaspina, D (2006). Family History of Affective Illness in Schizophrenia Patients and Cognitive Outcomes. Neuropsychopharmacology. 31:S122.
- Anglin, D, Stanford, AD, Malaspina, D. (submitted). Family history of affective versus psychotic disorder influences neurocognition and symptom expression in schizophrenia.
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- Avery, D.H., Isenberg, K.E., Sampson, S.M., Janicak, P.G., Lisanby, S.H., Maixner, D., Loo, C., George, M.S.: Transcranial magnetic stimulation (TMS) in the Acute Treatment of Major Depression: Clinical Response in an Open-Label Extension Trial. Submitted.
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- Battaglia F, Quartarone A, Rizzo V, Ghilardi FM, DiRocco A, Tortorella G, Girlanda P. Early impairment of synaptic plasticity in patients with Down's syndrome *Neurobiology of Aging*, 2007, Mar 29
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- Corcoran C, Stanford AD, Malaspina D. (in press). The Schizophrenia Prodrome, In: *Frontiers in Biological Psychiatry in Childhood Exploring the Relationship Among Genes, Brain Development, and the Emergence of Psychopathology*, ed. Morrow, EM, Rosenbaum, JF, Fava, M, Biederman, J. American Psychiatric Publishing, Arlington, VA.
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