McGovern Institute for Brain Research

The McGovern Institute for Brain Research at MIT is led by a team of world-renowned neuroscientists committed to meeting two great challenges of modern science: understanding how the brain works and discovering new ways to prevent or treat brain disorders. The McGovern Institute was established in 2000 by Patrick J. McGovern and Lore Harp McGovern, who are committed to improving human welfare, communication, and understanding through their support for neuroscience research.

Faculty Changes

Feng Zhang joined the McGovern Institute and Department of Brain and Cognitive Sciences, where he is an assistant professor. He also has a joint appointment as a core member of the Broad Institute. Dr. Zhang earned his PhD from Stanford University, after which he was a junior fellow at Harvard University's Society of Fellows, working in the laboratory of George Church. Dr. Zhang has recently developed a new method for creating customized DNA-binding proteins that can be targeted to any genomic sequence, and he plans to use these as a platform technology for manipulating gene expression in the nervous system.

Chris Moore will leave MIT in July 2011 to become a tenured professor in the Department of Neuroscience at Brown University. With the arrival of Feng Zhang and the departure of Chris Moore, our total faculty count remains unchanged at 16.

Administrative Changes

Our development officer, Laurie Ledeen, left in January 2011 for another position at MIT. We have appointed a new development officer, Kara Flyg, who will join the institute in August 2011.

Annual Symposium

The theme of our 2011 symposium was Inhibition and Neural Circuit Function. The symposium was organized by Yingxi Lin of the McGovern Institute, and included eight speakers from the United States and Europe.

Scolnick Prize

The 2011 Scolnick Prize winner is Bruce McEwen of Rockefeller University. McEwen was the first to discover brain receptors for the stress hormones known as corticosteroids and he has also made major contributions to our knowledge of sex differences in the brain. The prize ceremony and lecture will take place on September 26, 2011.

Sharp Lecture

The McGovern Institute received a $100,000 gift from Biogen-Idec to establish an annual lecture in honor of Institute Professor Philip Sharp, who was the founding director of the McGovern Institute and a co-founder of Biogen, where he served on the board for many years. The theme of the lecture will be neural circuits, and the inaugural speaker will be Dr. Okihide Hikosaka who is a senior investigator at the National Institutes of Health and a pioneer in the study of basal ganglia.

Annual Retreat

The McGovern Institute's annual retreat was held for a third year at the American Academy of Arts and Sciences in Cambridge, MA. The event featured 14 talks and 26 poster presentations from McGovern labs, followed by dinner at the academy. In addition to around 100 members of the institute, the audience included McGovern Institute cofounder Lore McGovern.

Anniversary Celebration

The McGovern Institute celebrated its 10th anniversary on October 14, 2010, with a symposium and dinner for invited guests. Guest speakers included actor Alan Alda, host of the PBS series *Scientific American Frontiers*; TV journalist Jane Pauley, a member of the McGovern Institute's Leadership Board and a prominent advocate for mental health research; and Gerald Fischbach, scientific director of the Simons Foundation.

McGovern Institute, a Model for China

Patrick McGovern, chairman of International Data Group Inc. (IDG) and cofounder of the McGovern Institute at MIT, and top officials of Tsinghua University, signed an agreement in April 2011 to establish the IDG/McGovern Institute for Brain Research at Tsinghua University in Beijing. Planning is still at an early stage but the new institute will be modeled on the McGovern Institute at MIT. We look forward to developing a close collaborative relationship with our new colleagues in China.

Board of Directors

The McGovern Board of Directors meets quarterly, in July, October, January, and April. The membership of the board remains unchanged since last year, and includes: Patrick McGovern; Lore McGovern; Elizabeth McGovern; Marc Kastner, MIT; Robert Langer, MIT; Edward Scolnick, Broad Institute; Sheila Widnall, MIT; and James Poitras, Avalon Mining, Inc.

The McGovern Leadership Board

The McGovern Leadership Board meets twice per year, in April and October. The Leadership Board participates in programming at the McGovern Institute and interacts with the director and faculty members throughout the year, providing critical funding and strategic advice to the McGovern Institute.

Core Laboratories

The magnetoencephalography laboratory, which was made possible by a $4M fundraising campaign, became operational in spring 2011. The lab will serve as a core facility for the local neuroscience research community and is expected to support a wide range of studies on human brain function in health and disease. Dr. Dimitrios Pantazis, an expert on neuroimaging data analysis, was recruited from the University of Southern California to run the new lab.

The McGovern Institute has also established a 2-photon microscopy core laboratory, made possible with a $1.4M stimulus grant from the NIH. The lab serves as a core

facility open to all MIT neuroscience researchers, and the steering committee includes representation from the McGovern and Picower Institutes, the Media Lab, and the Department of Electrical Engineering and Computer Science. Martha Constantine-Paton has been the lead coordinator of this project and we are grateful for her efforts on behalf of the MIT neuroscience community.

McGovern Institute Neurotechnology Program

The McGovern Institute Neurotechnology Program provides seed funding for collaborations between McGovern labs and researchers from other disciplines, with a focus on developing new technologies for brain research. Recent projects have covered many different areas, including development of new methods for optogenetics, a new device for simultaneous injection and in vivo recording, new methods for tracing neural connections with viruses, and the development of a molecular barcoding method for analyzing gene expression in single cells in the living brain.

Awards and Honors

Ed Boyden gave an invited TED talk in March 2011 on the optogenetic technology that he helped to invent. Boyden also received an Allen Distinguished Investigator Award from the Paul G. Allen Family Foundation.

Tomaso Poggio was identified as one of the most highly cited Italian scientists by the Virtual Italian Academy, which conferred on him the title "Most Eclectic Scientist" based on the impact of his work across multiple disciplines.

Our promotional video, *Welcome to the McGovern Institute*, won a CINE Golden Eagle Award. This was the second industry award for the video, which also won a Telly Award the previous year.

Alan Jasanoff, an associate member of the institute, was awarded tenure in the Department of Biological Engineering.

Major Research Publications During the Reporting Period

Nancy Kanwisher's group described a powerful new fMRI-based method for localizing language areas of the brain in individual subjects. *Journal of Neurophysiology*, August 2010, 104(2):1177–94.

Tomaso Poggio and colleagues describe a computer vision algorithm that can learn to classify behaviors of caged mice. The method may prove useful for assessing the effects of gene mutations or candidate drugs on standard behavioral tests. *Nature Communications*, September 2010, 7; 1:68.

Jim Dicarlo's lab reported evidence that unsupervised learning mechanisms can explain how the brain learns to recognize objects independent of their size. *Neuron*, September 2010, 67(6):1062–75.

Tomaso Poggio's group presented a model for how the brain processes a visual scene, first making a 'map' of interesting visual features and then focusing spatial and object-based attention on features of interest. *Vision Research*, October 2010, 50(22):2233–47.

Michale Fee and colleagues showed that the timing of bird song is controlled by a cascade of neural activity. This may be a general mechanism for controlling complex action sequences with precise timing. *Nature*, November 2010, 468(7322):394–9.

Institute Professor Ann Graybiel and colleagues described how habitual behaviors emerge spontaneously and change over time. By studying monkeys' eye movements as they scan a visual display repeatedly, the researchers found that the animals settle on habitual sequences that tend to minimize the distance traveled by the eyes. *PNAS*, November 2010, 23; 107(47):20512–7.

Bob Horvitz and colleagues described how a single asymmetric cell division in early development leads to the later emergence of bilateral asymmetry in the *C elegans* nervous system. *Development*, December 2010, 137(23):4017–27

Ed Boyden, in collaboration with Clif Fonstad of the Department of Electrical Engineering and Computer Sciences, described a new class of devices for delivering light to precise locations within the brain. The devices are used for optogenetic studies in which brain activity is controlled by light. *Optics Letters*, December 2010; 35(24):4133–5.

John Gabrieli and colleagues at Stanford University identified patterns of brain activity and morphology in children with dyslexia that are predictive of how well the children's reading skills will improve over a 2.5-year period. *PNAS*, January 2011, 108(1):361–6.

Feng Zhang, in collaboration with the labs of George Church and Paola Arlotta at Harvard University, described a method for producing customized DNA-binding proteins that can be targeted to any DNA sequence. This approach has broad potential for manipulating gene expression in vivo. *Nature Biotechnology*, February 2011, 29(2):149–53.

John Gabrieli, in collaboration with Rebecca Saxe, showed that autistic individuals differ in moral judgments, giving more weight to outcomes rather than intentions when assigning blame. *PNAS*, February 2011, 108(7):2688–92.

Chris Moore, Ann Graybiel, Ed Boyden, and their collaborators at Harvard, used a combination of optogenetics and fMRI to map functional connectivity within the mouse brain. *Journal of Neurophysiology*, March 2011, 105(3):1393–405.

Guoping Feng's lab described a mouse model of autism based on mutations in the synaptic protein Shank3, which is also implicated in human autism. The mutant mice show deficits in social interaction that are likely attributable to dysfunction of cortico-striatal connections. *Nature*, April 2011, 472(7344):437-42

Robert Desimone, Tomaso Poggio, and colleagues described how visual attention influences neural representations of objects within ventral visual cortex. These effects

may underlie the brain's ability to recognize single attended objects in a complex visual scene. *PNAS*, May 2011, 108(21):8850–5.

Robert Desimone's group described interactions between prefrontal and visual cortical areas that may underlie feature-based attention, guiding the eyes toward a searched-for target. *Neuron*, June 2011, 70(6):1205–17.

Ed Boyden, along with colleagues at University of Southern California, showed that gene therapy with the light-sensitive protein channelrhodopsin-2 can promote recovery of visual function in a mouse model of retinal blindness. *Molecular Therapy*, July 2011, 19(7):1220–9.

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