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 Lore Harp McGovern and the late Patrick J. McGovern with the goal of improving human welfare, communication, and understanding through support for neuroscience research.

Faculty

The department had 15 faculty and four associate faculty members during the period July 1, 2018, to June 30, 2019. Professor Martha Constantine-Paton retired on December 31, 2018, and Assistant Professor Gloria Choi moved her appointment to another institute at MIT on December 31, 2018. Both Ila Fiete and Joshua McDermott became associate investigators.

McGovern Institute Fellows Program

The McGovern Institute created a new program, the McGovern Institute Fellows Program, and appointed Omar Abudayyeh and Jonathan Gootenberg as inaugural fellows. On January 1, 2019, Abudayyeh and Gootenberg moved into space originally allocated to Professor Feng Zhang. They have received modest start-up funding and a guarantee of their salaries for three years.

Resource Development

Fundraising from individuals and private foundations remains a priority at the McGovern Institute. McGovern Institute staff hosted multiple donor cultivation events during the fiscal year, and faculty and staff met with more than 75 donors and prospects in Cambridge, London, New York, Florida, and California. The institute continues to raise significant gifts and pledges to fund cutting-edge research.

Poitras Center for Psychiatric Disease Research

A $10 million commitment to the Poitras Center from Jim and Pat Poitras enables us to pursue new therapeutic approaches to psychiatric disorders and non-psychiatric human disease. Expanding beyond CRISPR-based therapies, Feng Zhang will lead the effort to develop new types of therapeutic agents and new types of “delivery vehicles” for these agents so that they can be used effectively in human patients. Guoping Feng will also be supported in his efforts to develop certain types of gene therapies that could be used in a variety of diseases. Existing funds in the Poitras Center will continue its support of projects related to psychiatric disorders, including the very productive work of John and Susan Gabrieli in human patients.

Center for Brains, Minds and Machines and MIT Quest

In September 2018, David Siegel made a gift through the MIT Quest for Intelligence initiative to support the Center for Brains, Minds and Machines “Moonshot” project, which seeks to understand intelligence. The total gift commitment is $10 million over a period of five years, with the annual allotment ramping up each year.

Professors Tomaso Poggio, James DiCarlo, Robert Desimone, and Max Tegmark have started work on their Quest- funded seed project titled "Biological Learning Mechanisms for Deep Learning." The main aim of the project is to bridge the gap in visual learning between artificial neural networks and biological organisms. The latter are able to learn based on only a few labeled examples. The seed project's goal is to combine theoretical, experimental, and modeling tools and study learning in primates while building artificial neural networks that predict the neural activity and behavior of the brain during learning. Frederico Azevedo, a postdoctoral researcher in Professor Desimone's lab, is working on the project.

McGovern Institutes in China

The McGovern Institute at MIT continues to collaborate and interact with the three International Data Group/McGovern Institutes in China at Tsinghua University, Beijing Normal University, and Peking University. We also have a continuing collaboration with the Shenzhen Institutes of Advanced Technology.

Board of Directors

The McGovern Board of Directors meets quarterly, in July, October, January, and April. Membership of the board for FY2019 was as follows: Lore McGovern; Elizabeth McGovern; Michelle Bethel; Michael Sipser, MIT; Robert Langer, MIT; James Poitras; and Lisa Yang.

McGovern Institute Leadership Board

The McGovern Institute Leadership Board meets once per year. The 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 institute.

Major Events

Edward M. Scolnick Prize in Neuroscience

Richard Huganir was selected as the winner of the 2019 Scolnick Prize. The prize was awarded on May 8, 2019, with a talk followed by a public reception and private dinner. Huganir is the Bloomberg Distinguished Professor of Neuroscience and Psychological and Brain Sciences and director of the Solomon H. Snyder Department of Neuroscience at Johns Hopkins University. His lab focuses on the mechanisms that regulate synaptic transmission and synaptic plasticity. The lab has shown that receptor protein phosphorylation and the regulation of the synaptic targeting of receptors are dynamically regulated and regulate the efficiency of synaptic transmission. They are currently focusing efforts on the mechanisms that underlie the regulation of the glutamate receptors, the major excitatory neurotransmitter receptors in the brain. These receptors are neurotransmitter-dependent ion channels that allow ions to pass through the neuronal cell membrane, resulting in the excitation of neuronal activity.

Phillip A. Sharp Lecture in Neural Circuits

The annual Phillip A. Sharp Lecture in Neural Circuits (endowed by Biogen Idec in honor of the McGovern Institute's founding director, Phillip Sharp) was given on May

28, 2019, at MIT by Yang Dan, professor of neurobiology at the University of California, Berkeley. Using a combination of electrophysiology, imaging, and computational methods, Dan's lab has provided important insights into the microcircuits underlying visual cortical computation and cellular mechanisms for functional plasticity. In particular, her lab revealed the functional consequences of spike-timing-dependent plasticity at multiple levels, from synapse to circuits to perception. Recent work has revealed the mechanisms by which neuromodulatory circuits exert powerful control of brain states and sensory processing.

Building 46 Colloquium Series

The McGovern Institute, Picower Institute, and Department of Brain and Cognitive Sciences continued to support a weekly colloquium series in Building 46. The events featured a robust list of speakers and talks followed by public receptions. Speakers during the fall were Michael Brect, Jeffrey Magee, and Josh Gold. Dan Polley, Elizabeth Buffalo, and Barry Connors spoke in the spring.

Seminar Series in Psychiatric Research

The Poitras Center and the Stanley Center continued to jointly sponsor a monthly seminar series. During the fall, talks took place on Tuesdays in the McGovern Auditorium at the Broad Institute. The series took a hiatus for the remainder of the year with anticipation that it will resume in FY2020.

The Beautiful Brain

The McGovern Institute hosted several events in relation to *The Beautiful Brain* exhibit at the MIT Museum in October:

- A screening of the documentary *Santiago Ramón y Cajal: Butterflies of the Soul* with speaker Javier DeFelipe from Instituto Cajal
- A special seminar: "Inspired by Ramón y Cajal: Rafael Yuste"

Gairdner Award Celebration

On October 25, Ed Boyden was presented with the Gairdner Award at a celebration in Toronto, Canada. This was the second consecutive year that one of our faculty had been awarded the Gairdner.

Martha Constantine-Paton Emeritus Dinner

On November 16, the department honored Martha Constantine-Paton on her transition from professor to professor emeritus.

Hock E. Tan and K. Lisa Yang Center for Autism Research Board Meeting

On November 30, the department held the second Tan-Yang Center scientific advisory board meeting. The meeting featured talks by researchers who had received Tan-Yang funding toward their work.

Spring 2019 Symposium in Honor of Patrick J. McGovern

On March 18, 2019, the five-year anniversary of Pat McGovern's death, we celebrated Pat's legacy with a joint symposium with the McGovern Institutes in China and SIAT (Shenzhen Institutes of Advanced Technology). The symposium was followed by a reception and dinner.

McGovern Institute Annual Retreat

The McGovern Institute annual retreat was held on June 3–4, 2019, in Falmouth, MA. The event featured talks, a poster session, a career corner, and many opportunities for our laboratories to connect with one another.

Science of Reading Symposium

To examine the state of literacy education in America, the McGovern Institute and the MIT Integrated Learning Initiative hosted a symposium on literacy and research science, convening experts in education and neuroscience to determine the best path to ensuring that students are not only learning to read but taught to read through more effective, rigorously researched methods. The symposium, led by John Gabrieli and Parag Pathak, was held in Cambridge on June 4. The event featured thought leaders in reading education as well as scientific lightning talks that shed light on early childhood literacy.

Hock E. Tan and K. Lisa Yang Center for Autism Research Retreat

On June 13, 2019, the department held a retreat for Boston-area researchers studying autism. There were almost 70 attendees: 30 principal investigators who each brought one or two members of their labs. Researchers working in clinical settings on genetic models, gene therapy, and sequencing cohorts of individuals diagnosed with autism were all represented. The goal of the retreat, which was held at the recommendation of the scientific advisory board of the Tan-Yang Center, was to bring leading investigators using parallel approaches to study and treat autism together to increase collaborations and interactions. Key topics of discussion included ways of addressing the variability in phenotypes among individuals diagnosed with autism and how to move forward with new genetic models, including primate models. Speakers included members of the Tan-Yang Center (Guoping Feng, Rebecca Saxe, and Feng Zhang) as well as guest speaker David Ginty of Harvard University, who has been studying sensory hypersensitivity, a trait observed in some individuals with autism. The general set-up and approach of the Tan-Yang Center—combining genetic animal models with better-powered human studies—has emerged as important for the field more broadly. There was also a general agreement that this type of retreat, with fewer formal talks and more focused discussions, was a useful format for future meetings. We will begin planning another meeting for next year, with some international participation.

MIT Quest for Intelligence

The Center for Brains, Minds and Machines (CBMM) is a core component of the new MIT Quest for Intelligence. The leadership team for MIT Quest includes CBMM and McGovern Institute investigators in key roles. James DiCarlo was named as director of The Core, which will advance the science and engineering of both human and machine intelligence, and Tomaso Poggio will be The Core's founding scientific advisor.

MIT Stephen A. Schwarzman College of Computing

McGovern faculty, including Jim DiCarlo (organizational structure working group), Rebecca Saxe (social implications and responsibilities working group), and Josh McDermott (computing infrastructure working group), have been participants in working groups involved in planning the structure and operation of the new Stephen A. Schwarzman College of Computing.

Core Facilities

The McGovern Institute operates several core laboratories that serve the local neuroscience community, including but not confined to members of the institute.

Martinos Imaging Center at MIT

The Martinos Center provides access to neuroimaging technologies, including two 3T magnetic resonance imaging (MRI) scanners for human brain imaging, a 9.4T MRI scanner for small animal imaging, a magnetoencephalography scanner, and an electroencephalography system. There is also a coil fabrication lab and a mock MRI scanner to help subjects (especially children) adapt to the scanning environment.

Two-Photon Microscopy Core

This core features a sophisticated two-photon system with four lasers to support two-color imaging and uncaging. The system includes two workstations, configured for slice physiology and whole animal work. It has been upgraded to include an electrophysiology system. The core, managed by Mark Harnett, is provided free of charge to those in Building 46.

OpenMind Computing Cluster

This cluster was established in 2014 to provide the MIT brain research community with access to state-of-the-art computing resources. The cluster is housed at the Massachusetts Green High Performance Computing Center in Holyoke, MA, with a 10 gigabit link to the MIT campus.

McGovern Institute Neurotechnology Program

The McGovern Institute Neurotechnology Program (MINT) continues to provide seed funding for collaborations between McGovern laboratories and researchers from other disciplines within MIT, with a focus on developing new technologies for brain research. Since its establishment in 2006, the MINT program has supported over 40 projects. Collaborating principal investigators are from multiple departments and schools at MIT.

Awards and Honors

Michale Fee has been selected to receive a McKnight Technological Innovations in Neuroscience Award for his research on new technologies for imaging and analyzing neural state-space trajectories in freely behaving small animals.

Mark Harnett has been named a 2018 Vallee Foundation Scholar for his “original, innovative, and pioneering” work exploring the biophysical features of neurons. In addition, he is one of six young researchers selected to receive a prestigious 2019 McKnight Scholar Award. The award supports his research "studying how dendrites, the antenna-like input structures of neurons, contribute to computation in neural networks."

Rebecca Saxe has been named the inaugural John W. Jarve (1978) Professor in Brain and Cognitive Sciences. Also, she received a "Committed to Caring" honor from MIT's Office of Graduate Education for excellent mentorship of graduate students.

Feng Zhang won the 2018 Keio Medical Science Prize for "outstanding and creative achievements made in the life and medical sciences." He was also named one of *Fortune* magazine's 40 under 40 for his work pioneering the use of CRISPR in human cells.

Emilio Bizzi received the Lifetime Achievement Award from the Italian Scientists and Scholars of North America Foundation.

Michael Halassa has been named a Max Planck Fellow by the Max Planck Florida Institute for Neuroscience, which forges collaborations between exceptional neuroscientists from around the world to answer fundamental questions about brain development and function.

Ed Boyden was presented the 2018 Gairdner International Award at a ceremony in Toronto on October 25. He received the award for his contributions to the discovery of optogenetics. In addition, Boyden has been elected to the National Academy of Sciences for "distinguished and continuing achievements in original research." Boyden has also been awarded the Croonian Medal, the Royal Society's premier biological science lectureship; the Warren Alpert Prize for his contributions to the development of optogenetics; and the Lennart Nilsson Award, an international award bestowed annually upon an individual in recognition of outstanding contributions within the realm of scientific photography.

Guoping Feng has been elected to the American Academy of Arts and Sciences for "relentless pursuit of knowledge in all of its forms."

Research Highlights

Are the Eyes the Window to the Soul?

Covert attention has been defined as shifting attention without shifting the eyes. The notion that we can internally pay attention to an object in a scene without making eye movements to it has been a cornerstone of the fields of psychology and cognitive neuroscience, which attempt to understand mental phenomena that are purely internal to the mind, divorced from movements of the eyes or limbs. A study out of the Desimone lab now questions the dissociation of eye movements from attention in this context, finding that microsaccades precede modulation of specific brain regions associated with attention. In other words, a small shift of the eyes is linked to covert attention after all. (July 17, 2018)

Charting the Cerebellum

Small and tucked away under the cerebral hemispheres toward the back of the brain, the human cerebellum is still immediately obvious due to its distinct structure. From Galen's second-century anatomical description to Cajal's systematic analysis of its projections, the cerebellum has long drawn the eyes of researchers studying the brain. Two parallel studies out of the Martinos Imaging Center have recently converged to support an unexpectedly complex level of non-motor cerebellar organization—including possible links to autism spectrum disorder—that would not have been predicted from known motor representation regions. (July 31, 2018)

Testing the Limits of Artificial Visual Recognition Systems

A major goal for artificial visual recognition systems is to be able to distinguish objects in the way that humans do. However, such recognition has traditionally been a challenge for artificial visual recognition systems. The DiCarlo lab has now directly examined and shown that artificial object recognition is quickly becoming more primate-like but still lags when scrutinized at higher resolution. (August 3, 2018)

Neuroscientists Get at the Roots of Pessimism

Many patients with neuropsychiatric disorders such as anxiety or depression experience negative moods that lead them to focus on the possible downside of a given situation more than the potential benefit. Ann Graybiel has pinpointed a brain region that can generate this type of pessimistic mood. In tests in animals, Graybiel and her group showed that stimulating this region, known as the caudate nucleus, induced animals to make more negative decisions than when the region was not stimulated: they gave far more weight to the anticipated drawback of a situation than its benefit. These findings could help scientists better understand how some of the crippling effects of depression and anxiety arise and guide them in developing new treatments. (August 9, 2018)

A Social Side to Face Recognition by Infants

When interacting with an infant, you have likely noticed that the human face holds a special draw from a very young age. But how does this relate to face recognition by adults, which is known to map to specific cortical regions? Rebecca Saxe and her team considered two emerging theories regarding early face recognition and came up with a third proposition, arguing that when a baby looks at a face, the response is also social, and that the resulting contingent interactions are key to subsequent development of organized face recognition areas in the brain. (August 20, 2018)

Constructing the Striatum

The striatum, the largest nucleus of the basal ganglia in the vertebrate brain, was historically thought to be a homogeneous group of cells. This view was overturned in a classic series of papers from Ann Graybiel. She and her colleagues have now mapped the developmental lineage of cells that give rise to this complex architecture. They found that different functions of the striatum, such as execution of actions as opposed to evaluation of outcomes, are defined early on as part of the blueprint that constructs this brain region rather than sculpted through a later mechanism. (August 21, 2018)

New Sensors Track Dopamine in the Brain for More Than a Year

Dopamine, a signaling molecule used throughout the brain, plays a major role in regulating our mood as well as controlling movement. Many disorders, including Parkinson's disease, depression, and schizophrenia, are linked to dopamine deficiencies. Ann Graybiel and her colleagues have devised a way to measure dopamine in the brain for more than a year, and they believe their method will help them learn much more about its role in both healthy and diseased brains. (September 12, 2018)

Electrical Properties of Dendrites Help Explain the Brain's Unique Computing Power

Neurons in the human brain receive electrical signals from thousands of other cells, and long neural extensions called dendrites play a critical role in incorporating all of this information so that the cells can respond appropriately. Using hard-to-obtain samples of human brain tissue, Mark Harnett has discovered that human dendrites have different electrical properties from those of other species. These differences may contribute to the enhanced computing power of the human brain. (October 18, 2018)

Monitoring Electromagnetic Signals in the Brain with MRI

Researchers commonly study brain function by monitoring two types of electromagnetism: electric fields and light. However, most methods for measuring these phenomena in the brain are very invasive. Engineers in Alan Jasanoff's lab have devised a new technique to detect either electrical activity or optical signals in the brain using a minimally invasive sensor for magnetic resonance imaging. (October 22, 2018)

How the Brain Overcomes Its Own Limitations

Imagine trying to write your name so that it can be read in a mirror. Your brain has all of the visual information you need, and you are a pro at writing your own name. Still, this task is very difficult for most people because the brain must perform a mental transformation that it is not familiar with using what it sees in the mirror to accurately guide your hand to write backward. Mehrdad Jazayeri has discovered how the brain tries to compensate for its poor performance in tasks that require this kind of complicated transformation. As it also does in other types of situations in which it has little confidence in its own judgments, the brain attempts to overcome its difficulties by relying on previous experiences. (October 24, 2018)

Tracking Down Changes in Attention-Deficit/Hyperactivity Disorder

Attention-deficit/hyperactivity disorder (ADHD) is marked by difficulty maintaining focus on tasks and by increased activity and impulsivity. These symptoms ultimately interfere with the ability to learn and function in daily tasks, but the source of the problem could reside at different levels of brain function and it is hard to parse out exactly what is going wrong. Michael Halassa has developed tasks that dissociate lower- from higher- level brain functions so that disruptions in these processes can be more specifically checked in ADHD. The results of his study illuminate how brain function is disrupted in ADHD and highlight a role for perceptual deficits in this condition. (October 28, 2018)

Brain Activity Pattern May Be Early Sign of Schizophrenia

Schizophrenia, a brain disorder that produces hallucinations, delusions, and cognitive impairments, usually strikes during adolescence or young adulthood. While some signs might suggest that a person is at high risk for developing the disorder, there is no way to definitively diagnose it until the first psychotic episode occurs. Susan Whitfield-Gabrieli and her collaborators have identified a pattern of brain activity correlated with the development of schizophrenia that they say could be used as a marker to diagnose the disease earlier. (November 8, 2018)

How the Brain Switches between Different Sets of Rules

Cognitive flexibility—the brain's ability to switch between different rules or action plans depending on the context—is key to many of our everyday activities. A new study out of the Halassa lab has found that a region of the thalamus is key to the process of switching between the rules required for different contexts. This region, called the mediodorsal thalamus, suppresses representations that are not currently needed. That suppression protects the representations as short-term memories that can be reactivated when needed. (November 10, 2018)

A Method to Shrink Objects to the Nanoscale

Ed Boyden's team has invented a way to fabricate nanoscale 3D objects of nearly any shape. They can also pattern the objects with a variety of useful materials, including metals, quantum dots, and DNA. Using the new technique, the researchers can create any shape and structure they want by patterning a polymer scaffold with a laser. After attaching other useful materials to the scaffold, they shrink it, generating structures one thousandth the volume of the original. These tiny structures could have applications in many fields, from optics to medicine to robotics, the researchers say. The technique uses equipment that many biology and materials science labs already have, making it widely accessible for researchers who want to try it. (December 14, 2018)

Mapping the Brain at High Resolution

Ed Boyden's team has developed a new way to image the brain with unprecedented resolution and speed. Using this approach, they can locate individual neurons, trace connections between them, and visualize organelles inside neurons over large volumes of brain tissue. The new technology combines a method for expanding brain tissue, making it possible to image at higher resolution, with a rapid 3D microscopy technique known as lattice light-sheet microscopy. (January 17, 2019)

Scientists Engineer a New CRISPR Platform for DNA Targeting

Feng Zhang has engineered another CRISPR system, called Cas12b, that can target and precisely nick or edit the genomes of human cells. The high target specificity and small size of Cas12b from *Bacillus hisashii* (BhCas12b) relative to Cas9 (SpCas9) make this new system suitable for in vivo applications. The Zhang team is now making CRISPR-Cas12b widely available for research. (January 22, 2019)

Peering under the Hood of Fake- News Detectors

New work from CBMM researchers peers under the hood of an automated fake-news detection system, revealing how machine-learning models catch subtle but consistent differences in the language of factual and false stories. The research also underscores how fake-news detectors should undergo more rigorous testing to be effective in real-world applications. (February 6, 2019)

MRI Sensor Images Deep Brain Activity

Calcium is a critical signaling molecule for most cells, and it is especially important in neurons. Imaging calcium in brain cells can reveal how neurons communicate with each other; however, current imaging techniques can penetrate only a few millimeters into the brain. Alan Jasanoff has devised a new way to image calcium activity that is based on MRI and allows a much deeper look into the brain. Using this technique, Jasanoff and his group can track signaling processes inside the neurons of living animals, enabling them to link neural activity with specific behaviors. (February 22, 2019)

How Motion Conveys Emotion in the Face

While a static emoji can stand in for emotion, in real life we are constantly reading into the feelings of others through subtle facial movements. The Saxe lab has monitored changes in brain activity as subjects followed face movements in movies of avatars. Their findings suggest that we can generalize across individual face part movements in other people but that a particular cortical region, the face-responsive superior temporal sulcus (fSTS), is also responding to isolated movements of individual face parts. The fSTS seems to be tied to kinematics, individual face part movement, more than the implied emotional cause of that movement. (March 11, 2019)

How the Brain Distinguishes between Objects

As visual information flows into the brain through the retina, the visual cortex transforms the sensory input into coherent perceptions. Neuroscientists have long hypothesized that a part of the visual cortex, called the inferotemporal cortex, is necessary for the key task of recognizing individual objects, but the evidence has been inconclusive. In a new study, the DiCarlo lab has found clear evidence that the inferotemporal cortex is indeed required for object recognition; they also found that subsets of this region are responsible for distinguishing different objects. (March 13, 2019)

How the Brain Decodes Familiar Faces

Our brains are incredibly good at processing faces and even have specific regions specialized for this function. But what face dimensions are we observing? Do we observe global properties first and then process the details? Or are dimensions such as gender and other identity details decoded interdependently? In a new study, Nancy Kanwisher and her group measured the response of the brain to faces in real time and found that the brain first decodes properties such as gender and age before drilling down to the specific identity of the face itself. They also found that our brains recognize gender more quickly in familiar faces than unfamiliar faces. (March 19, 2019)

Neuroscientists Reverse Symptoms of Williams Syndrome

In a study of mice, Guoping Feng's lab has garnered new insight into the molecular mechanisms that underlie Williams Syndrome. They found that loss of one of the genes linked to Williams Syndrome leads to a thinning of myelin, the fatty layer that insulates neurons and helps them conduct electrical signals in the brain. The researchers also showed that they could reverse the symptoms by boosting production of this coating. This is significant because, while Williams Syndrome is rare, many other neurodevelopmental disorders and neurological conditions have been linked to myelination deficits. (April 22, 2019)

Recurrent Architecture Enhances Object Recognition

James DiCarlo and his colleagues have found evidence that feedback improves recognition of hard-to-recognize objects in the primate brain and that adding feedback circuitry also improves the performance of artificial neural network systems used for vision applications. (April 29, 2019)

Putting Vision Models to the Test

The DiCarlo lab has performed the most rigorous testing yet of computational models that mimic the brain's visual cortex. Using their current best model of the brain's visual neural network, the researchers designed a new way to precisely control individual neurons and populations of neurons in the middle of that network. In an animal study, the team then showed that the information gained from the computational model enabled them to create images that strongly activated specific brain neurons of their choosing. The findings suggest that the current versions of these models are similar enough to the brain that they could be used to control brain states in animals. (May 2, 2019)

Antenna-Like Inputs Unexpectedly Active in Neural Computation

Most neurons have many branching extensions called dendrites that receive input from thousands of other neurons. Dendrites are not just passive information carriers, however. According to a new study from the Harnett lab, they appear to play a surprisingly large role in neurons' ability to translate incoming signals into electrical activity. Neuroscientists had previously suspected that dendrites might be active only rarely, under specific circumstances, but Harnett's team found that dendrites are nearly always active when the main cell body of the neuron is active. (June 6, 2019)

The Brain Appears Uniquely Tuned for Musical Pitch

In the eternal search for understanding what makes us human, scientists at the National Institutes of Health and the McDermott lab found that our brains are more sensitive to pitch, the harmonic sounds we hear when listening to music, than our evolutionary relative the macaque monkey. (June 11, 2019)

New Gene-Editing System Precisely Inserts Large DNA Sequences into Cellular DNA

Feng Zhang has characterized and engineered a new gene-editing system that can precisely and efficiently insert large DNA sequences into a genome. The system, harnessed from cyanobacteria and called CRISPR-associated transposase (CAST), allows efficient introduction of DNA while reducing the potential error-prone steps in the process—adding key capabilities to gene-editing technology and addressing a long-sought goal for precision gene editing. (June 11, 2019)

How We Tune Out Distractions

Michael Halassa and his group have identified a brain circuit that helps us tune out distractions. The circuit they identified, which is controlled by the prefrontal cortex, filters out unwanted background noise or other distracting sensory stimuli. When the circuit is engaged, the prefrontal cortex selectively suppresses sensory input as it flows into the thalamus, the site where most sensory information enters the brain. (June 12, 2019)

McGovern Neuroscientists Develop a New Model for Autism

The Desimone and Feng labs, in collaboration with researchers in China, have used the genome-editing system CRISPR to engineer macaque monkeys to express a gene mutation linked to autism and other neurodevelopmental disorders in humans. These monkeys show some behavioral traits and brain connectivity patterns similar to those seen in humans with these conditions. The new model could help scientists develop better treatment options for certain neurodevelopmental disorders. (June 12, 2019)

A Chemical Approach to Imaging Cells from the Inside

Researchers in Feng Zhang's lab have developed a new technique for mapping cells. The approach, called DNA microscopy, shows how biomolecules such as DNA and RNA are organized in cells and tissues, revealing spatial and molecular information that is not easily accessible through other microscopy methods. DNA microscopy also does not require specialized equipment, enabling large numbers of samples to be processed simultaneously. (June 20, 2019)

Selected Press

Boston Globe reporter Martin Finucane wrote that MIT researchers have identified the region of the brain responsible for generating negative emotions. "The findings could help scientists better understand how some of the effects of depression and anxiety arise, and guide development of new treatments," Finucane explained. (*Boston Globe*, August 9, 2018)

Neuroscientists at MIT have pinpointed the region of the brain responsible for negative decision making, depression, and anxiety, opening the door for future treatments. (*Daily Mail*, August 10, 2018)

"A federal appeals court on Monday struck another blow against the University of California's hopes of invalidating key CRISPR patents held by the Broad Institute of MIT and Harvard, ruling unanimously that a US patent board correctly concluded that the Broad's patents did not 'interfere' with those that UC had applied for," wrote STAT News reporter Sharon Begley. "The decision allows the Broad to keep its patents, the first of which was awarded in 2014, on the foundational CRISPR-Cas9 genome editing technology for eukaryotic cells invented by Feng Zhang." (STAT News, September 10, 2018)

According to *Boston Globe* reporter Martin Finucane, MIT researchers have developed sensors that can track dopamine levels in the brain. The sensors could eventually be used to monitor "Parkinson's patients who receive a treatment called deep brain stimulation," Finucane explained, adding that the sensors could "help deliver the stimulation only when it's needed." (*Boston Globe*, September 12, 2018)

John Gabrieli was quoted in a *New York Times* story about Yale dyslexia researchers Sally and Bennett Shaywitz. (*New York Times*, September 21, 2018)

Popular Mechanics writer Jacqueline Detwiler profiled Polina Anikeeva, the "engineer who wants to build better brain interface devices." (*Popular Mechanics*, October 3, 2018)

STAT News reporters documented the timeline around He Jiankui's announcement at the Hong Kong Summit on Human Genome Editing that he created the world's first genetically engineered babies. (STAT News, November 26, 2018)

Feng Zhang spoke with WBUR about claims that a Chinese scientist created the world's first genetically modified babies. (WBUR, November 26, 2018)

Inside Science reporter Yuen Yiu wrote that MIT researchers have developed a new technique for producing nanoscale structures using a 3D printing method that shrinks objects. According to Yiu, the new technique operates by "first creating a bigger structure inside of a gel, then shrinking the gel, which brings the structure down to one-thousandth the volume of the original." (*Inside Science*, December 13, 2018)

Douglas Heaven of *New Scientist* reported that MIT researchers have developed a new method to shrink 3D printed objects. The technique can be used to create a wide variety of shapes using different materials. "In the 1970s hobbyists built their own computers at home," explained Professor Ed Boyden. "Maybe people can now make their own chips." (*New Scientist*, December 13, 2018)

MIT researchers have developed a new technique that can shrink objects to the nanoscale using a laser, according to CNN's Lauren Kent. Kent explained that the technology "could be applied to anything from developing smaller microscope and cell phone lenses to creating tiny robots that improve everyday life." (CNN, December 18, 2018)

Popular Mechanics reporter David Grossman wrote about a new fabrication technique developed by MIT researchers that allows for regular-sized objects to be shrunk down to the nanoscale. Grossman explained that the new method "takes a technique currently used to make images of brain tissue larger and reverses it." (*Popular Mechanics*, December 18, 2018)

According to *Boston Globe* reporter Martin Finucane, MIT researchers have developed a new way to fabricate tiny objects. "The researchers are currently able to create objects that are around 1 cubic millimeter, with features as small as 50 nanometers," Finucane explained. "The tiny structures could be useful in fields from optics to medicine to robotics." (*Boston Globe*, December 20, 2018)

During Autism Awareness Month, *Asian American Life* (a nationally syndicated monthly news program on PBS) highlighted the contributions made by Asian Americans, including Lisa Yang and Guoping Feng, helping those living with autism. (PBS, April 2, 2019)

Robert Desimone
Director
Doris and Don Berkey Professor of Brain and Cognitive Sciences