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 McGovern Institute had 17 faculty and four associate members during the AY2018 reporting period. Professor Yingxi Lin was denied tenure and her appointment ended June 30, 2018. Mehrdad Jazayeri was promoted to associate professor without tenure. Both Michael Halassa and Polina Anikeeva became associate investigators at the McGovern Institute.

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, New York, Florida, and California. Its multi-year partnership with the MIT Museum resulted in the opening of *The Beautiful Brain* exhibition, which is expected to introduce more than 80,000 museum visitors to MIT's brain research programs.

The McGovern Institute raised over $4 million in outright cash gifts and $22.3 million in new pledges from individuals, companies, and family foundations in FY2018. Significant gifts included a new five-year commitment from the McGovern Foundation, the endowed Y. Eva Tan Professorship in Neurotechnology (currently held by Edward Boyden), an endowed postdoctoral fellowship fund, and numerous gifts of $500,000 and more to initiate novel research projects.

Major Events

The Edward M. Scolnick Prize in Neuroscience. The 2018 Scolnick Prize (endowed by Merck in honor of Edward M. Scolnick) was awarded to David Anderson from the California Institute of Technology. Though awarded in spring 2018, his lecture will not take place until September 2018.

The 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 by Scott Sternson from Janelia Research Campus/ Howard Hughes Medical Institute on April 25. The title was "The Neurobiology of Need."

Building 46 Colloquium Series. The McGovern Institute, Picower Institute for Learning and Memory, and Department of Brain and Cognitive Sciences continued to support a weekly colloquium series in Building 46 on Thursdays at 4:00 pm. The talks were each followed by a public reception. The McGovern Institute hosted the following speakers: Kazutoshi Nakazawa (10/12/17), Marla Feller (11/2/17), Michael Platt (12/7/17), Chris McBain (3/15/18), and Marlene Cohen (5/3/18).

The Poitras Center and Stanley Center Translational Joint Seminar Series. The Poitras Center and Stanley Center continued to jointly sponsor a monthly seminar series featuring leading researchers in psychiatric disorders. The AY2018 series featured the following speakers: Ben Deverman (9/21/17), Karen Parker (10/24/17), Dan Geschwind (10/31/17), Adam Gazzaley (12/12/17), Rita Valentino (2/13/18), Marina Picciotto (3/20/18), Susanne Ahmari (4/24/18), Mike Ehlers (5/29/18), and Michael Greenberg (6/19/18). Talks were held in the Singleton Auditorium in Building 46.

Scientific Advisory Board Meeting. The McGovern Institute for Brain Research Scientific Advisory Board met on Friday, November 3, 2017. The board meets every other year. Board members include John Duncan, Gerry Fishbach, Story Landis, Eve Marder, Josh Sanes, Edward Scolnick, Terry Sejnowski, Carla Shatz, Charles Stevens, Torsten Wiesel, and Robert Wurtz.

Hock E. Tan and K. Lisa Yang Center for Autism Research Scientific Advisory Board Meeting. On November 6, the McGovern Institute held the first advisory board meeting for the recently established Tan-Yang center. The meeting focused on talks by those scientists who have received Tan-Yang funding toward their research.

Bizzi Emeritus Dinner. On November 20, the McGovern Institute honored Emilio Bizzi at a dinner in his honor to mark his transition from Institute Professor to Institute Professor Emeritus.

McGovern Institute Spring Symposium. The McGovern Institute Spring Symposium was organized by Michael Halassa, a new associate investigator of the institute. The symposium was titled "Cortical interactions in cognitive control and flexibility." It took place on May 18, 2018, and featured eight speakers: Bruno Averbeck, Carlos Brody, Chris Eliasmith, Tatiana Engel, Stefano Fusi, Sabine Kastner, Anna Mitchell, and Mark Stokes.

Building 46 Retreat. The building-wide Brain and Cognitive Sciences, McGovern Institute, and Picower Institute Retreat was held in Newport, RI on June 4-5, 2018. It was attended by over 300 researchers, faculty, and staff. There were nine talks, a poster session, and many opportunities to interact and get to know fellow researchers.

McGovern Institutes in China

The McGovern Institute at MIT continues to collaborate and interact with the three IDG-McGovern Institutes in China: Tsinghua University, Beijing Normal University, and Peking University. The McGovern Institute also has a burgeoning collaboration with Shenzhen Institutes of Advanced Technology.

Board of Directors

The McGovern Board of Directors meets on a quarterly basis in July, October, January, and April. The membership of the board consisted of Lore McGovern, Elizabeth McGovern, Michelle Bethel, Michael Sipser, Robert Langer, James Poitras, and Lisa Yang. Sheila Widnall rotated off the Board in January 2017.

The McGovern Institute Leadership Board

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

James and Patricia Poitras Neuroscience Chair

Feng Zhang was named the inaugural chair holder of the James and Patricia Poitras (1963) Professorship in Neuroscience. This newly endowed professorship was made possible through a generous gift by Patricia and James Poitras ’63.

Core Facilities

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

Martinos Imaging Center

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 was upgraded to include an electrophysiology system. The core is managed by Mark Harnett and is provided free of charge to those in neuroscience in Building 46.

OpenMind Computing Cluster

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

McGovern Institute Neurotechnology Program

The McGovern Institute Neurotechnology Program (MINT) continues to provide seed funding for collaborations between McGovern labs 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 37 projects. Collaborating principal investigators are from multiple departments and schools at MIT.

Awards and Honors

Edward Boyden was among 11 MIT faculty members elected to the American Academy of Arts and Sciences this year. Earl Miller of the Picower Institute for Learning and

Memory and Mary Potter, professor emerita of psychology in the Department of Brain and Cognitive Sciences, were also elected. The new class was inducted at a ceremony on October 7 , 2017, in Cambridge, MA.

Boyden was awarded the inaugural Drexel Prize in Biotechnology at Drexel University's International Symposium on Molecular Medicine and Infectious Disease. He also received the 2018 Canada Gairdner International Award, which is Canada's most prestigious scientific prize, for his role in the discovery of light-gated ion channels and optogenetics, a technology to control brain activity with light, and was named the inaugural Y. Eva Tan Professor in Neurotechnology. The new professorship was established at the McGovern Institute by K. Lisa Yang in honor of her daughter Y. Eva Tan.

Ed Boyden, Fei Chen, and Feng Zhang were among 10 MIT and Broad researchers who received 2017 National Institutes of Health Director's Awards. Boyden is a recipient of the Transformative Research Award, which promotes "cross-cutting, interdisciplinary approaches that could potentially create or challenge existing paradigms." Chen, a Broad Institute fellow who is also a research affiliate at the McGovern Institute for Brain Research, received the Early Independence Award, which recognizes "exceptional junior scientists" with an opportunity to skip traditional postdoctoral training and move immediately into independent research positions. Zhang received the Pioneer Award, which challenges scientists to pursue "groundbreaking, high-impact approaches to a broad area of biomedical or behavioral science."

Feng Zhang and Ed Boyden were named Howard Hughes Medical Institute (HHMI) Investigators. They join a community of 300 HHMI scientists who are "transforming biology and medicine, one discovery at a time." Both researchers have been instrumental in recognizing, developing, and sharing robust tools with broad utility that have revolutionized the life sciences.

Robert Desimone and Earl Miller received the Brain and Cognitive Sciences Award for Excellence in Graduate Teaching.

Ann Graybiel won the 2018 Gruber Neuroscience Prize for her pioneering work on the structure, organization, and function of the basal ganglia. She was awarded the prize alongside Okihide Hikosaka of the National Institutes of Health's National Eye Institute, and Wolfram Schultz of the University of Cambridge in the U.K.

Michael Halassa, who joined the McGovern Institute as an associate investigator, was named as a finalist for the Takeda Innovator in Science early career award. Associate Professor Kay Tye was also a finalist for the award, which honors "commitment to and excellence in neuroscience research."

Nancy Kanwisher won the Davida Teller Award, which honors female scientists who have made exceptional contributions to the field of vision science and have a strong history of mentoring. Kanwisher was also a recipient of the 2018 Heineken Prize, which is the Netherlands' most prestigious scientific prize, for her work on the functional organization of the human brain.

Tomaso Poggio was presented with the sixth PAMI Azriel Rosenfeld Lifetime Achievement Award at the International Conference on Computer Vision in October in Venice, Italy. The award was established to "honor outstanding researchers who are recognized as making significant contributions to the field of computer vision over longtime careers."

Feng Zhang, a pioneer of the revolutionary CRISPR gene-editing technology, TAL effector proteins, and optogenics, was the recipient of the 2017 Lemelson-MIT Prize, the 2017 Albany Medical Center Prize in Medicine and Biomedical Research, and the 2017 Blavatnick National Award for Young Scientists. In addition, Feng Zhang was elected to the American Academy of Arts and Sciences and the National Academy of Sciences for his work developing molecular biology tools, including the CRISPR-Cas9 system.

Foreign Policy magazine named Feng Zhang among its list of "Global reThinkers" who are the "doers who defined 2017."

Omar Abudayyeh and Jonathan Gootenberg, doctoral candidates in Feng Zhang's lab, were named to the 2017 Forbes "30 under 30" list for their work "identifying a new enzyme for editing genes and a new technique for editing RNA."

Feng Zhang was awarded the Vilcek Prize for Creative Promise in Biomedical Science. Polina Anikeeva, an associate professor of materials science and engineering and a McGovern Institute associate investigator, was also a prize recipient. The $50,000 annual prizes recognize younger immigrants who have demonstrated exceptional promise early in their careers.

Summary of Research Advances

July 17, 2017

Expansion Pathology' technique could enable more informative biopsies

The Boyden Laboratory has devised a way to image biopsy samples with much higher resolution—an advance that could help doctors develop more accurate and inexpensive diagnostic tests. The new technique, termed "ExPath," relies on an approach known as expansion microscopy, in which researchers expand a tissue sample to 100 times its original volume before imaging it. In a paper published in *Nature Biotechnology*, Boyden and his colleagues combine the ExPath technique with computational image analysis to distinguish early-stage breast lesions with high or low risk of progressing to cancer—a task that is difficult for pathologists using conventional microscopic methods.

August 30, 2017

Robotic system offers easier monitoring of single neurons

Recording electrical signals from inside a neuron in the living brain can reveal a great deal of information, but it is very difficult, and only a handful of labs worldwide have the expertise to perform such recordings. To make this technique more widely available, Ed Boyden and his collaborators have devised a way to automate the process using a computer algorithm that analyzes microscope images and guides a robotic arm to the target cell. This technology will allow more scientists to study single neurons and learn how they interact with other cells to enable cognition, perception, and other brain functions.

September 13, 2017

Studies explore link between autism and severe infection in pregnancy

Mothers who experience an infection severe enough to require hospitalization during pregnancy are at higher risk of having a child with autism. Two new studies from the lab of Gloria Choi and collaborators at the University of Massachusetts Medical School shed more light on this phenomenon and identify possible approaches to preventing it.

October 25, 2017

Researchers engineer CRISPR to edit single RNA letters in human cells

Feng Zhang, who first harnessed CRISPR for genome editing, has engineered a new CRISPR-based system for editing RNA in human cells. This method makes it possible to repair mutated RNAs and proteins without altering the genome itself. In a paper published in *Science*, Zhang describes the new system, called RNA Editing for Programmable A to I Replacement (REPAIR). The system can change single RNA nucleotides in mammalian cells in a precise fashion. REPAIR has the ability to reverse disease-causing mutations at the RNA level, with profound implications for both research and disease treatment.

November 13, 2017

Next-generation optogenetic molecules control single neurons

Ed Boyden and colleagues at Paris Descartes University have developed a new optogenetic technique that sculpts light to target individual neurons, allowing them to be stimulated with precise timing within the living brain. This new advance paves the way for studies of how individual cells, and connections among those cells, generate specific behaviors such as initiating a movement or learning a new skill.

November 16, 2017

Chronic stress impairs decision-making

Making decisions is not always easy, especially when choosing between two options that have both positive and negative elements, such as deciding between a job with a high salary but long hours, and a lower-paying job that allows for more leisure time. Ann Graybiel's lab has now discovered that making decisions in this type of situation, known as a cost-benefit conflict, is dramatically affected by chronic stress. In a study of mice, they found that stressed animals were far likelier to choose high-risk, high-payoff options.

December 4, 2017

How the brain keeps time

Timing is critical for playing a musical instrument, swinging a baseball bat, and many other activities. Many researchers have argued for the existence of a centralized clock, or pacemaker, somewhere in the brain that keeps time for the entire brain. However, a new study from Mehrdad Jazayeri's lab provides evidence for an alternative timekeeping system that relies on the neurons responsible for producing a specific action. Depending on the time interval required, these neurons compress or stretch out the steps they take to generate the behavior at a specific time.

January 24, 2018

Ultrathin needle can deliver drugs directly to the brain

Ann Graybiel and colleagues have devised a miniaturized system that can deliver tiny quantities of medicine to brain regions as small as 1 cubic millimeter. This type of targeted dosing could make it possible to treat diseases that affect very specific brain circuits, without interfering with the normal function of the rest of the brain.

February 8, 2018

Distinctive brain pattern helps habits form

Ann Graybiel has found that certain neurons in the brain are responsible for marking the beginning and end of chunked units of behavior. These neurons, located in a brain region highly involved in habit formation, fire at the outset of a learned routine, go quiet while it is carried out, then fire again once the routine has ended.

February 8, 2018

Study reveals molecular mechanisms of memory formation

Yingxi Lin has uncovered a cellular pathway that allows specific synapses to become stronger during memory formation. The findings provide the first glimpse of the molecular mechanism by which long-term memories are encoded in a region of the hippocampus called CA3. The researchers found that a protein called Npas4, previously identified as a master controller of gene expression triggered by neuronal activity, controls the strength of connections between neurons in the CA3 and those in another part of the hippocampus called the dentate gyrus. Without Npas4, long-term memories cannot form.

February 14, 2018

Back-and-forth exchanges boost children's brain response to language

John Gabrieli has found that conversation between an adult and a child appears to change the child's brain, and that this back-and-forth conversation is critical to language development. In a study of children between the ages of four and six, they found that differences in the number of "conversational turns" accounted for a large portion of the differences in brain physiology and language skills that they found among the children. This finding applied to children regardless of parental income or education. The findings suggest that parents can have considerable influence over their children's language and brain development by simply engaging them in conversation, the researchers say.

February 15, 2018

Researchers advance CRISPR-based tool for diagnosing disease

Feng Zhang's team, which first unveiled the rapid, inexpensive, highly sensitive CRISPR-based diagnostic tool called SHERLOCK, has greatly enhanced the tool's power, and has developed a miniature paper test that allows results to be seen with the naked eye and without the need for expensive equipment. This new feature helps pave the way for field use, such as during an outbreak. The team has now increased the sensitivity of SHERLOCK and added the capacity to accurately quantify the amount of target in a

sample and test for multiple targets at once. All together, these advancements accelerate SHERLOCK's ability to quickly and precisely detect genetic signatures, including pathogens and tumor DNA, in samples.

February 26, 2018

Seeing the brain's electrical activity

Neurons in the brain communicate via rapid electrical impulses that allow the brain to coordinate behavior, sensation, thoughts, and emotion. Ed Boyden has come up with a new approach to measuring electrical activity in the brain, which he believes will prove much easier and more informative. His team has developed a light-sensitive protein that can be embedded into neuron membranes, where it emits a fluorescent signal proportional to voltage changers in cells. The new technique allows neuroscientists to track neural activity with an imaging camera, faster than when measuring calcium changes, the currently dominant imaging technology. The new method could allow scientists to study how neurons behave, millisecond by millisecond, as the brain performs a particular function.

March 6, 2018

Viral tool traces long-term neuron activity

For the past decade, neuroscientists have been using a modified version of the rabies virus to label neurons and trace the connections between them. Although this technique has proven very useful, it has one major drawback: The virus is toxic to cells and can't be used for studies longer than about two weeks. Ian Wickersham and colleagues at the Allen Institute for Brain Science have now developed a new version of this virus that stops replicating once it infects a cell, allowing it to deliver its genetic cargo without harming the cell. Using this technique, scientists should be able to study the infected neurons for several months, enabling longer-term studies of neuron functions and connections.

March 6, 2018

Study reveals how the brain tracks objects in motion

Catching a bouncing ball or hitting a ball with a racket requires estimating when the ball will arrive. Neuroscientists have long thought that the brain does this by calculating the speed of the moving object. However, a new study from Mehrdad Jazayeri's lab shows that the brain's approach is more complex. In addition to tracking speed, the brain incorporates information about the rhythmic patterns of an object's movement, for example, how long it takes a ball to complete one bounce. In their new study, the researchers found that people make much more accurate estimates when they have access to information about both the speed of a moving object and the timing of its rhythmic patterns.

March 12, 2018

Study finds early signatures of the social brain

Humans use an ability known as theory of mind every time they make inferences about someone else's mental state. Behavioral studies have suggested that children

begin succeeding at a key measure of this ability, known as the false-belief task, around age four. A new study out of Rebecca Saxe's lab has found that the brain network that controls theory of mind has already formed in children as young as three. The study is the first to use Functional magnetic resonance imaging (fMRI) to scan the brains of children as young as age three as they perform a task requiring theory of mind.

April 30, 2018

Calcium-based MRI sensor enables more sensitive brain imaging

Alan Jasanoff's lab has developed a new MRI sensor to monitor neural activity deep within the brain by tracking calcium ions. Because calcium ions are directly linked to neuronal firing—unlike the changes in blood flow detected by other types of MRI, which provide an indirect signal—this new type of sensing could allow researchers to link specific brain functions to their pattern of neuron activity, and to determine how distant brain regions communicate with each other during particular tasks.

May 4, 2018

Biologists discover function of gene linked to familial ALS

MIT biologists have discovered a function of a gene that is believed to account for up to 40 percent of all familial cases of amyotrophic lateral sclerosis (ALS). Studies of ALS patients have shown that an abnormally expanded region of DNA in a specific region of this gene can cause the disease. In a study of the microscopic worm *Caenorhabditis elegans*, researchers in the Horvitz lab found that the gene has a key role in helping cells to remove waste products via structures known as lysosomes. When the gene is mutated, these unwanted substances build up inside cells. The researchers believe that if this also happens in neurons of human ALS patients, it could account for some of those patients' symptoms.

June 6, 2018

How the brain performs flexible computations

Humans can perform a vast array of mental operations and adjust their behavioral responses based on external instructions and internal beliefs. For example, to tap your feet to a musical beat, your brain has to process the incoming sound and also use your internal knowledge of how the song goes. Mehrdad Jazayeri has now identified a strategy that the brain uses to rapidly select and flexibly perform different mental operations. To make this discovery, they applied a mathematical framework known as dynamical systems analysis to understand the logic that governs the evolution of neural activity across large populations of neurons.

June 25, 2018

How music lessons can improve language skills

Many studies have shown that musical training can enhance language skills. However, it was unknown whether music lessons improve general cognitive ability, leading to better language proficiency, or if the effect of music is more specific to language processing. A new study by Robert Desimone, in collaboration with John Gabrieli, Chen Chen Gong,

and colleagues at Beijing Normal University, has found that piano lessons have a very specific effect on kindergartners' ability to distinguish different pitches. This translates into an improvement in discriminating between spoken words, which is believed to aid in learning to read. However, the piano lessons did not appear to confer any benefit for overall cognitive ability, as measured by IQ, attention span, and working memory.

Press Mentions

Scientific American, "Disease hunters enlarge the enemy to get a better look" (August 1, 2017)
New "expansion pathology" technique lets optical microscopes go where only electrons could go before.

Stat News, "Not just for CRISPR: Lemelson-MIT Prize honors Feng Zhang for 'big ideas that change fields'" (September 19, 2017)
The $500,000 Lemelson-MIT Prize is being awarded this year to bioengineer Feng Zhang, a key developer of CRISPR genome-editing technology.

Forbes, "How to find and sustain breakthrough ideas in science" (October 2, 2017)
"I think the key to being successful at getting funding is to be sure you can clearly explain what your vision and idea is," says Feng Zhang. "The future with your vision is going to be a much brighter future."

Forbes, "An MIT professor wants to bring entrepreneurs into the lab" (October 3, 2017)
The work of a scientist in a lab is like climbing a mountain, according to Ed Boyden. The scientist is focused on reaching the summit and answering her burning research question, but "halfway up the mountain are all sorts of ways we can spin out things to help other people," Boyden said at *Forbes'* 2017 Under 30 Summit in Boston.

The Scientist, "CRISPR system targets RNA in mammalian cells" (October 4, 2017)
Researchers engineer bacterial CRISPR-Cas13 to knock down RNA in mammalian cells.

Wall Street Journal, "Scientists use new CRISPR system to edit RNA in human cells" (October 25, 2017)
Professor Feng Zhang and his colleagues have created a CRISPR-based system that can edit RNA in human cells, reports Amy Dockser Marcus for the *Wall Street Journal.* "The new RNA-editing system, which the scientists have dubbed REPAIR, allows the editing of individual RNA letters, correcting a common mutation known to play a role in a number of diseases."

Los Angeles Times, "How scientists hope to treat diseases by editing our RNA" (October 25, 2017)
MIT scientists have developed a technique that could potentially be used one day to treat diseases of the brain, muscles, liver, and kidneys by using CRISPR to edit RNA, writes Melissa Healy. Making edits to the chemical message of RNA, "doesn't effect a permanent change in a cell's architectural plan; rather, it essentially alters the implementation of that plan," explains Healy.

Rolling Stone, "25 people shaping the future in tech, science, medicine, activism and more" (November 17, 2017)
Feng Zhang's CRISPR gene editing technology is now leading breakthroughs in treating HIV, cancer, and neurodegenerative diseases to say nothing of its potential for re-engineering coral reefs and harnessing algae's biopower. "It's like a renaissance period," Zhang says. "We have wanted to do this for a long time, and we are now reaching a stage where we can."

Newsweek, "Why stress leads us to make bad decisions and do stupid things" (November 18, 2017)
A new study by MIT researchers shows how stress can lead people to make risky decisions, reports Kristin Hugo for *Newsweek*. "The study lends insights into how neurological disorders affect people. It could be the stress of dealing with inabilities to function properly and staving off cravings, compounded with the chemical effects on the brain, that are influencing people's uninhibited behavior."

The Boston Globe, "MIT researchers find alternative evidence of how the brain keeps time" (December 4, 2017)
MIT researchers have found that a network of neurons compress or stretch their activity in order to control the brain's timing, reports Alyssa Meyers. "Instead of passively waiting for a clock to reach a certain point, the team found the system of neurons changes its state independently based on the action being performed."

Newsweek, "How the brain keeps time finally discovered by scientists" (December 4, 2017)
Joseph Frankel writes that MIT researchers have found that the brain relies on a network of neurons to keep track of time. The researchers found that, "neurons appear to fire in a similar pattern, whether operating at fast or slow speeds…. But interestingly, the same patterns stretch or compress over time, depending on the rate of the task."

The Scientist, "Top Technical Advances in 2017" (December 25, 2017)
The year's most impressive achievements according to The Scientist include Feng Zhang's new methods to extend CRISPR editing, and Ed Boyden's robotic patch-clamp technique.

Quanta Magazine, "A neurobiologist thinks big – and small" (January 18, 2018)
Ed Boyden has grand dreams. The aims of this neuroscientist include decoding all of biology and achieving human enlightenment.

Associated Press, "Tiny implant opens way to deliver drugs deep into the brain" (January 24, 2018)
Lauran Neergaard writes that MIT researchers have developed a hair-thin implant that can deliver medications to specific regions of the brain. Neergaard indicates that the device "could mark a new approach to treating brain diseases – potentially reducing side effects by targeting only the hard-to-reach circuits that need care."

MIT Spectrum, "Plumbing the depths of neural nets" (February 2018)
On a quest to demystify deep learning, Tomaso Poggio glimpses tantalizing implications for human intelligence.

Wired, "To advance artificial intelligence, reverse-engineer the brain" (February 3, 2018)
Opinion piece by Jim DiCarlo.

Xinhua News Agency, "MIT study shows how brain pattern triggers habits" (February 9, 2018)
A study by MIT scientists has identified the neurons that fire at the beginning and end of activities, which is important for initiating a routine. "This task-bracketing appears to be important for initiating a routine and then motivating the brain once its complete."

WBUR, "MIT brain study: Back-and-forth talk key to developing kids' verbal skills" (February 14, 2018)
Professor John Gabrieli and graduate student Rachel Romeo speak with Carey Goldberg about their new research. "What we found is, the more often parents engaged in back-and-forth conversation with their child, the stronger was the brain response in the front of the brain to language," Gabrieli explains.

The Boston Globe, "Conversing with your children spurs young brain development, MIT study says" (February 15, 2018)
A new study from the McGovern Institute suggests that "one of the most effective ways to stimulate children's brains from a young age is back-and-forth conversation," writes Elise Takaham. "We think that it's because back-and-forth conversation is not only about hearing more words, it's also about practicing paying attention to someone else and involves a lot of emotional and social bonding," said John Gabrieli.

STAT, "With new CRISPR inventions, its pioneers say, you ain't seen nothin' yet" (February 15, 2018)
Originally created by the Zhang Lab in 2017, the CRISPR tool SHERLOCK has been improved upon to be three times more sensitive for detecting viruses and infections using an inexpensive test strip. Sharon Begley writes, "a paper strip, like in a pregnancy test, is dipped into a sample, and if a line appears, the target molecule was detected – no instruments required."

The Boston Globe, "MIT scientists take step toward treating memory loss diseases like Alzheimer's" (February 27, 2018)
Research published in *Neuron* may allow for the development of new treatments for disorders associated with memory loss. "It's possible that further research on the dentate gyrus-CA3 pathway could lead to ways to restore the synapses to allow memory formation again," Yingxi Lin told Elise Takahama.

Scientific American, "Brain scans may predict optimal mental health treatments" (March 2018)
Imaging technologies could find the best treatments for depression and addiction, and could even reshape education.

STAT, "These scientific images are both research tools and works of art" (March 8, 2018)
The Lin Lab studies Npas4, a gene that regulates not only the strength and size of these connections, but also the proteins (blue) located at these synapses. Examining the relationship between structure and function as these neurons interact at the cellular and molecular level, researchers can get a better picture of how memories are made.

The Boston Globe, "Brain scans show children as young as 3 can understand people's feelings" (March 12, 2018)
"A study led by graduate student Hilary Richardson provides evidence that by age 3, children have begun developing brain networks used to understand the beliefs and feelings of others," writes Laney Ruckstuhl.

STAT, "Scientists are thinking the unthinkable: CRISPR might one day reverse devastating brain diseases" (April 9, 2018)
The hottest question at the intersection of brains and genes is whether genome editing like CRISPR might reverse complicated brain disorders such as autism, Fragile X syndrome, frontotemporal dementia, Huntington's disease, schizophrenia, and others. "The answer is yes," said MIT neuroscientist Guoping Feng. "It is not only possible, it will be successful. There will be technical problems, but we will solve them."

WBUR, "CRISPR wizard Feng Zhang: the making of a sunny science superstar" (April 26, 2018)
"MIT's Feng Zhang, who is based at the Broad Institute in Cambridge and the McGovern, is a scientist who says he wants to change the world," WBUR's Carey Goldberg reports. "And he already has."

60 Minutes, "CRISPR: The gene-editing tool that's revolutionizing biomedical research" (April 29, 2018)
"A new tool could be the key to treating genetic diseases and may be the most consequential discovery in biomedicine this century."

WBUR, "2 MIT brain scientists explain 'Yanny vs. Laurel' Internet phenom" (May 17, 2018)
Carey Goldberg recommends a video with neuroscientists at the McGovern Institute "for a quick, light and smart explanation" of the 'Yanny vs. Laurel' debate. "The same acoustic information is hitting everyone's ears," says graduate student Kevin Sitek. "But the brain is then going to interpret that differently, based on experience."

The Boston Globe, "Six local biomed researchers awarded $8 million apiece, with no strings attached" (May 23, 2018)
Professors Edward Boyden and Feng Zhang have been named to the 2018 class of Howard Hughes Medical Institute investigators, reports Jonathan Saltzman. "We selected these scientists because they know how to ask hard and interesting questions with skill and intellectual courage," says David Clapham, vice president and chief scientific officer of the institute.

MIT Spectrum, "To the letter" (Spring 2018)
"In the Zhang lab, a leap forward in CRISPR-based genome editing offers precision RNA fixes with major therapeutic implications," writes Leda Zimmerman.

The Atlantic, "A CRISPR pioneer on gene editing: 'we shouldn't screw it up'" (June 7, 2018)
"The first thing many people notice about Feng Zhang—nearly every article written about him acknowledges it—is his relative youth," writes Sarah Zhang. "At just 36, with glasses and a round face that make him look even younger, the biologist has already made two

discoveries tipped to win Nobel Prizes. The big one, the one that shot Zhang to scientific celebrity, is CRISPR: a gene-editing tool that could allow precise alterations to human DNA…. Feng Zhang says many problems still have to be solved before the technology can be used to treat human diseases."

The Atlantic, "China is genetically engineering monkeys with brain disorders" (June 8, 2018)
"Recent investments in science have drawn Chinese graduate students and postdocs back from the West, and they have brought Western standards with them," writes Sarah Zhang. Collaborations with American researchers, like the one Guoping Feng and Robert Desimone have going at the Shenzhen Institutes of Advanced Technology, have also introduced Western standards to Chinese research institutions."

Xinhua News Agency (June 26, 2018)
A new study co-authored by MIT researchers uncovers evidence that music lessons can help improve a child's language skills, according to Xinhua. The researchers found that, "musical training is at least as beneficial in improving language skills, and possibly more beneficial, than offering children extra reading lessons."

ABC News, "Music education could help children improve their language skills" (June 25, 2018)
Denise Powell highlights a new study by MIT researchers that shows that music education could help a child's language skills. Powell explains that, "the results of this study give a boost of the idea of music training in kindergarten students as a method of enhancing the way brain cells and neurons process and respond to pitch."

Newsweek, "Scientists discover music lessons have yet another amazing benefit" (June 26, 2018)
A new study by MIT researchers shows that music lessons can help develop a child's language skills by improving their ability to differentiate between different pitches, reports Kashmira Gander. The researchers concluded that, "musical training helps to improve language skills, and could even be more beneficial than giving children additional reading lessons."

Scientific American, "Piano lessons tune up language skills" (June 26, 2018)
Robert Desimone speaks with Christopher Intagliata of Scientific American about his new research that shows how piano lessons can help improve a child's language skills. Desimone and his colleagues found that, "piano lessons can heighten the brain's response to changes in pitch. And kids who got piano lessons were also better at telling apart two similar-sounding words."

Robert Desimone
Director
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