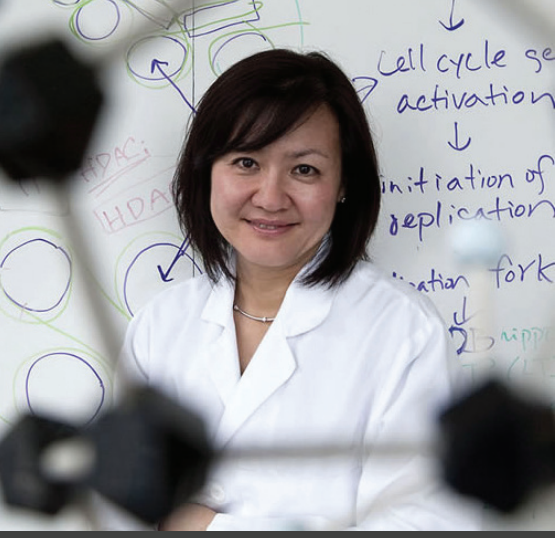
the SCIENCE of LEARNING

Neuroscience News

Summer 2015

THE PICOWER INSTITUTE
FOR LEARNING AND MEMORY



DIRECTOR'S MESSAGE

Dear Friend,

What is the science of learning and why does it matter?

Much of what we know to be good education practices comes from science. For example, research shows us that physical education improves attention, that repetition of information improves retention, and what we learn in early childhood is critical to laying the foundation of how we think. Nowadays, science is influencing the ways we implement educational technologies, tailor teaching interventions, and how to optimize the classroom environment.

The Picower Institute for Learning and Memory at MIT is dedicated to the science of how we learn and retain information. Our discoveries are revealing educational concepts such as how categories are learned, what governs mental flexibility, and how attention is focused. In this issue, we'll share new insights on how streams of information are separated into "good" and "bad" pathways and a mechanism for information representation in the brain. You'll also read about how memories are artificially re-activated, details on a master genetic regulator that contributes to schizophrenia, and how repairing DNA could lead to new approaches for preventing cognitive decline in disorders like Alzheimer's disease.

I encourage you to read more on the science of learning in this issue and how our findings will inform and improve education. I would also like to thank the Glenn Foundation for Medical Research for their support to better understand brain aging, Mr. Todd Siller for his gift of meaningful "thought" art, and the Dana and Betty Fisher Foundation for generously enabling our annual retreat by the sea. Please enjoy reading about our exciting breakthroughs, and the extraordinary diversity, and ingenuity of our team.

LI-HUEI TSAI, DIRECTOR

The Science of Learning

Optimizing Classroom Learning Through the Brain Sciences

The image of students sitting in rows, focused on an instructor, while memorizing facts is a foundational model of teaching. Although such a classroom environment may seem antiquated it is in fact rooted in sound neuroscience principles. For students to learn well they must maintain focus, practice material to better retain information, and have minimal distraction. As educational structures adapt and new technologies and interventions are incorporated, the incredible advancements made in understanding how the brain learns will continue to be helpful for informing future teaching methods. One need not look any further than at MIT's Picower Institute for Learning and Memory to see that neuroscience has exceptional potential to enhance the power of how students learn.

IN THIS ISSUE

Picower Institute researchers are studying how the brain learns and retains information, ranging from how we detect new information to concepts such as how the brain optimizes communication. As our scientists examine the nuances of brain processes, overarching concepts of learning are taking shape, which will impact how students learn in the classroom. It is well known that the brain of each student learns in a unique way and that learning can be improved by tailoring teaching methods to the individual. Neuroscience research could help usher in helpful innovation that will allow each student achieve their learning potential.

Picower Professor Earl Miller, for example, studies the brain regions responsible for sensory and cognitive functions such as attention and decision-making. His lab is dedicated to unraveling how information is shared between brain regions during tasks that require heightened attention, that is, how to keep information "in mind".

Miller has shown that multiple brain regions are simultaneously activated and share information when focused attention is required (read more on page 4). It turns out that even sensation-detecting regions of the brain are not just passively transmitting information as previously thought but rather are part of the decision-making process. These findings suggest that different brain systems should be optimally triggered in the classroom to build a richer learning experience. A broader repertoire of sensory and conceptual illustrations, (e.g., audition, vision, touch) in the classroom may be one way to fully engage brain regions that

underlie enhanced attention, learning, and memory.

In other work, Miller has found that paying attention to a single task is critical for effective learning. "When people think they're multitasking, they're actually just switching from one task to another very rapidly, and every time they do, there's a cognitive cost," Miller said.

"Multitasking prevents deep, creative thought as we switch back and forth, backtracking, constantly starting from scratch each time. As a result, thoughts are less new and more superficial."

Miller has also found that attention can quickly become overloaded when sensory information isn't presented optimally. Remarkably, cognitive capacity can be boosted when visual sensory information is presented in just the right way. Miller's new company, SplitSage, is developing new applied technologies to measure and tailor cognitive capacity enhancement for the general population.

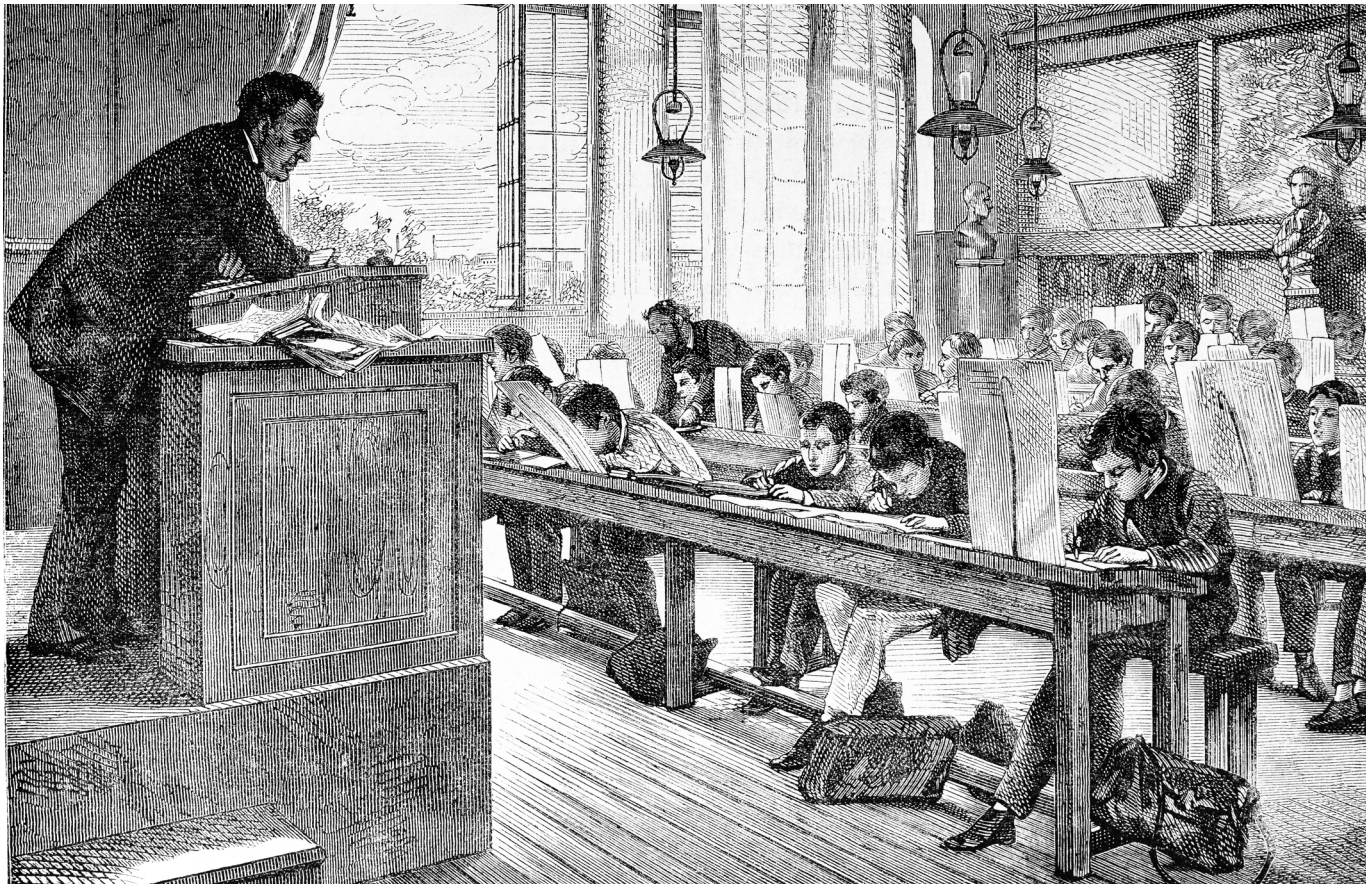
In **Picower Professor Mark Bear's lab**, scientists are uncovering ways in which the brain recognizes and perceives new information. Researchers in the Bear lab have found that early sensory processing areas in the visual system can learn to recognize novel patterns and they have identified brain states when recollection of these patterns is accurate, and when it is faulty.

The use of visual recognition to learn abstract concepts is already being implemented as a teaching tool. For example, students that use perception-training programs to match graphs to equations in quick succession learn the equations for the graphs. In essence, visual intuition is being tapped to help students build more nuanced understanding of mathematical problems. Figuring out how the brain quickly recognizes visual information will help determine the best way to use and train perceptual intuition. Moreover, programs like those mentioned can adjust automatically, tailoring to each student's unique way of learning.

The lab of **Picower Professor Susumu Tonegawa** is looking at the effects of dopamine on brain processing, which may give insight into the burgeoning problem of over diagnosing attention deficit hyperactivity disorder (ADHD). Dopamine is a brain chemical important for enhancing attention, processing rewarding information, and facilitating learning. Researchers have found that dopamine levels are increased when a correct answer is made and decreased when a mistake is made during learning. Release of dopamine is associated with a feeling of reward whereas reduced levels are associated with unpleasant feelings. Thus, dopamine is a powerful teaching signal that links reward to successful learning.

Too much or too little dopamine causes problems with attention and results in hyperactivity. Children with ADHD are thought to have a suboptimal amount of dopamine, leading to their poor

[Continued on page 4]



[Continued from page 3]

performance in school. Medication can optimize the amount of dopamine in those with ADHD. However, children that are misdiagnosed with ADHD and medicated when they don't have it, result in having too much dopamine in their brains and subsequent behavioral problems, lower grades, and often drug abuse. Understanding how dopamine levels optimize brain function will help doctors develop belter ADHD criteria in addition to informing policy decisions that make education an inherently rewarding experience.

In other work, **Picower Professor Matt Wilson's lab** researchers are discovering ways that could help teachers prepare the brains of student's to maximize learning. His group identified a phenomenon called replay – which is the process by which the brain recaptivates the events that happened during the day. Replay has been likened to dreaming or playing thoughts in your mind. Evidence suggests that replay boosts our ability to retain information and may be critical may be critical for extracting new relationships from memories as they are being replayed. Replay is triggered during sleep and quiet rest, and it may be possible to cause replay with the right types of sensory cues, which in turn would strengthen learning in students. Although it is not yet known how to stimulate such "re-thinking" we know that it is easy to provide students with the right context to induce replay. After new course material is given in class, for example, allowing students to have time for quiet rest would help them learn and retain the new information. Similarly, research has shown that when learning is paired with a specific smell, such as pumpkin pie, memory can be increased when the smell is presented again during sleep. It's quite possible that smell is an important trigger for replay.

Research from the Wilson lab provides further evidence that healthy sleep habits should be made a priority as part of a successful education.

In these examples of research conducted at the Picower institute of Learning and Memory, we see that now is the time to bridge neuroscience with education. Insights from neuroscience will provide educators with a scientific basis for understanding and debunking widely used teaching practices and can offer new and far-reaching methodologies to maximizing learning. From engaging multiple sensory modalities, to optimizing the presentation of visual information, and supporting the replay of recently learnt information, the neuroscience of learning and memory has only begun to show the incredible potential of how brain sciences will transform classroom learning.

Using All of Your **Brain**

Artist rendition of brain activity shared simultaneously throughout the brain.

Conventional theory held that you could tell what was going on in the cortex simply by identifying its parts: the visual cortex encodes color and motion, for instance, while frontal and middle regions control decision-making. Neuroscientists have long criticized this view as too compartmentalized.

Picower Institute Professor Earl Miller

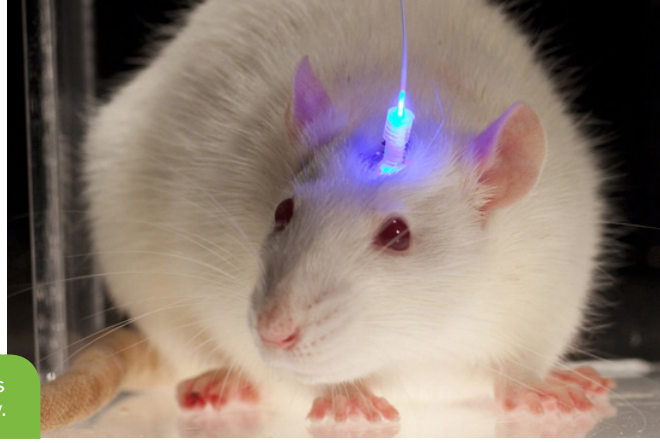
Earl Miller shows that, indeed, multiple cortical regions work together simultaneously to process sensorimotor information — sensory input coupled with related actions — despite their predetermined specialized roles.

The researchers used cutting-edge techniques to record neural activity simultaneously for the first time across six cortical regions during a task in which the color or motion of dots had to be identified. These regions, ranging from the front to back of the brain, were thought to each specialize in specific sensory or executive functions. Yet the researchers found significant encoding for all information across all regions — but at varying degrees of strength and timing. These findings, Miller says, could lead to improved treatments for brain disease, attention deficit hyperactivity disorder, stroke, and trauma. "A lot of these [issues] are things going wrong with the cortex, where our critical thought occurs," he says. "By having a better understanding of how the cortex processes information, we'll have a better way to treat them in the future."

Published in **Science**.

Cortical information flow during flexible sensorimotor decisions. Siegel, M., Buschman, T.J., and Miller, E.K. Science. June 19, 2015

Going to a Happy Place



An illuminated fibrotic cable activates specific neurons to alter brain activity.

MIT neuroscientists have shown that they can reverse the symptoms of depression in mice by artificially re-activating happy memories that were formed before the onset of depression. Researchers in **Susumu Tonegawa's lab** used optogenetics, a technology that allows brain cells to become strongly activated by using laser light.

Picower Institute Professor Susumu Tonegawa

The findings offer a possible explanation for the success of psychotherapies in which depression patients are encouraged to recall pleasant experiences. They also suggest new ways to treat depression by manipulating the brain cells where memories are stored. The researchers believe this kind of targeted approach could have fewer side effects than most existing antidepressant drugs, which bathe the entire brain.

"Once you identify specific sites in the memory circuit which are not functioning well, or whose boosting will bring a beneficial consequence, there is a possibility of inventing new medical technology where the improvement will be targeted to the specific part of the circuit, rather than administering a drug and letting that drug function everywhere in the brain," says Susumu Tonegawa, who headed up the study. Although this type of intervention is not yet possible in humans, "This type of analysis gives information as to where to target specific disorders," Tonegawa adds.

Published in **Nature**.
Activating positive memory engrams suppresses depression-like behavior. Steve Ramirez, Xu Liu et al. Nature. June 18, 2015.

Older Brains Break More DNA

Each time we learn something new, our brain cells break their DNA, creating damage that the neurons must immediately repair, according to **Li-Huei Tsai**, the Picower Professor of Neuroscience and director of the Picower Institute for Learning and Memory at MIT.

However, as we age, our cells' ability to repair this DNA damage weakens, Tsai says. Even in presymptomatic Alzheimer's,

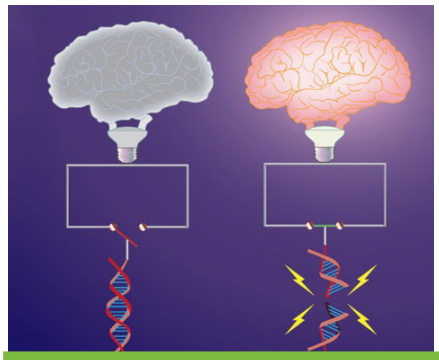
Picower Institute Director & Professor Li-Huei Tsai

neurons in the hippocampal region of the brain contain a large number of DNA lesions known as double strand breaks.

To determine what causes double strand breaks and which genes they affect, the researchers investigated what would happen if they created such damage in neurons. They discovered that of the 700 genes that showed changes, the vast majority had reduced expression levels, as expected. Surprisingly though, 12 genes — known to be those that respond rapidly to neuronal stimulation such as a new sensory experience — showed increased expression levels following the generation of double strand breaks.

To determine whether these breaks occur naturally during neuronal stimulation, the researchers then treated the neurons with a substance that causes synapses to strengthen in a similar way to exposure to a new experience.

"Sure enough, we found that the treatment very rapidly increased the expression of those early response genes, but it also caused DNA double strand breaks," Tsai says. The finding could lead to new approaches to preventing cognitive decline in disorders such as Alzheimer's disease.



Increased brain activity breaks DNA for a brief period of time. Breaking and then fixing DNA is a newly discovered natural and necessary process of turning genes on and off in the brain. As we age this process weakens.

Published in **Cell**.
Activity-Induced DNA Breaks Govern the Expression of Neuronal Early-Response Genes. Madabhushi, Ram, Gao, Fao et al. Cell. June 18, 2015.

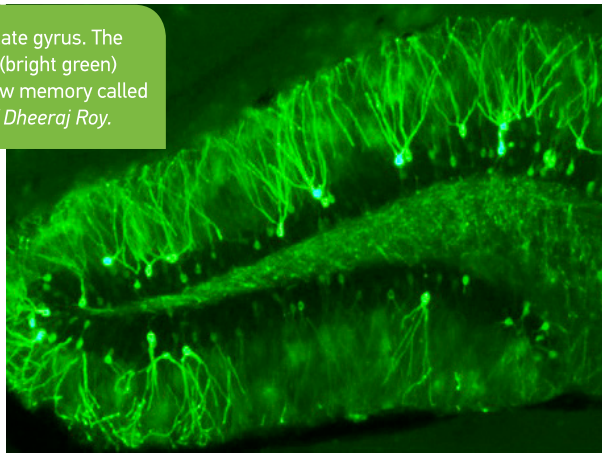
Finding **Lost Memories**

Memories that have been "lost" as a result of amnesia can be recalled by activating brain cells with light.

The finding shows that retrograde amnesia — which follows traumatic injury, stress, or diseases such as Alzheimer's--is a problem of retrieval impairment, according to **Susumu Tonegawa**, the Picower Professor in MIT's Department of Biology and director of the RIKEN-MIT Center at the Picower Institute for Learning and Memory, who directed the research by lead authors Tomás Ryan, Dheeraj Roy, and Michelle Pignatelli.

To find out if physical changes in neurons take place when memories are formed, the researchers first identified a group of engram cells in the hippocampus that, when activated using optogenetic tools, were able to express a memory.

When they then recorded the activity of this particular group of cells, they found that the synapses connecting them had been strengthened. Surprisingly, memories were able to be retrieved even after the researchers prevented the synapses from strengthening.



Illuminated neurons of the dentate gyrus. The collection of activated neurons (bright green) represent the formation of a new memory called an engram. *Graphic courtesy of Dheeraj Roy.*

Alcino Silva, director of the Integrative Center for Learning and Memory at the University of California at Los Angeles, said, "This groundbreaking paper suggests that changes in synaptic strength and in spine properties may not be as critical for memory as once thought, since under certain conditions, it seems to be possible to disrupt these changes and still preserve memory. Instead, it appears that these changes may be needed for memory retrieval, a mysterious process that has so far evaded neuroscientists."

Published in **Science**.

Engram cells retain memory under retrograde amnesia. Tomás J. Ryan, Dheeraj S. Roy, Michele Pignatelli et al. Science. May 29, 2015.

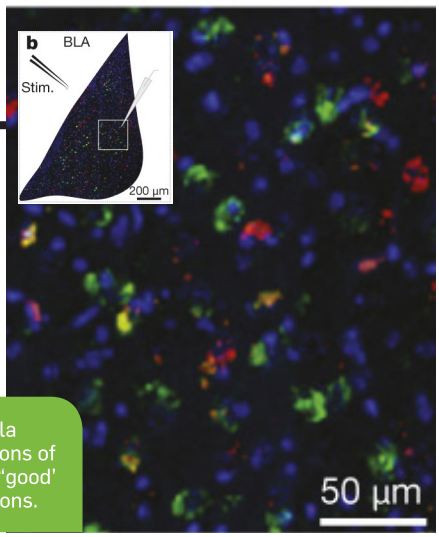
The **Good,** the **Bad,** and the **Amygdala**

Eating a slice of chocolate cake or spending time with a friend usually stimulates positive feelings, while getting in a car accident or anticipating a difficult exam is more likely to generate a fearful or anxious response.

Picower Institute Professor Kay Tye

An almond-shaped brain structure called the amygdala is believed to be responsible for assigning these emotional reactions. **Kay Tye's lab** found that two populations of neurons in the amygdala process positive and negative emotions, then relay the information to other brain regions that initiate the appropriate behavioral response.

"How do we tell if something is good or bad? Even though that seems like a very simple question, we really don't know how that process works," Tye says. "This study tells us that streams of information are hard-wired and are separated into good and bad at the level of the amygdala."



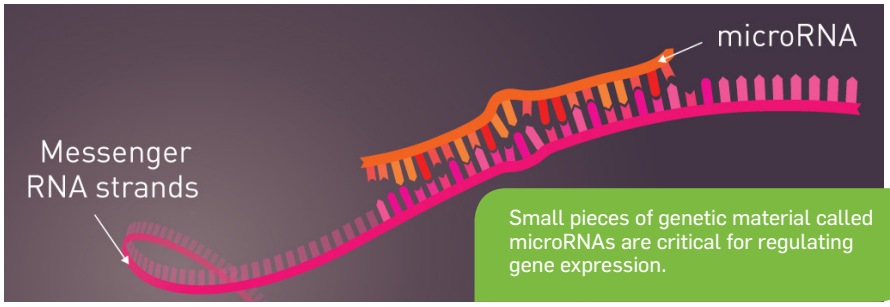
An outline of the amygdala (LEFT). Fluorescent neurons of the amygdala assigning "good' or "bad" emotional reactions.

The findings could help scientists to better understand how mental illnesses such as depression arise, she says. Many psychiatric symptoms may reflect impairments in emotional processing. For example, people who are depressed do not find positive experiences rewarding, and people who suffer from addiction are not deterred by the negative outcomes of their behavior.

Published in **Nature**.

A circuit mechanism for differentiating positive and negative associations. Praneeth Namburi, Anna Beyeler et al. Nature. 30 April 30, 2015.

Schizophrenia
Gene Degrades Brain Communication



Small pieces of genetic material called microRNAs are critical for regulating gene expression.

Researchers at MIT's Picower Institute for Learning and Memory have identified a master genetic regulator that could account for faulty brain functions that contribute to schizophrenia.

"The work may one day lead to new strategies for treating schizophrenia and other diseases caused by malfunctioning synapses, the connections among neurons," said **Li-Huei Tsai**, director of the Picower Institute and the Picower Professor of Neuroscience at MIT.

Messenger RNA (mRNA) translates DNA's genetic information into codes for proteins. A recently discovered class of noncoding RNA molecules, short stretches of RNA called microRNAs (miRNAs) has been shown to interact with mRNA and block protein production.

Genetic variations in the gene encoding miRNA-137 have been linked with an increased risk for schizophrenia. While schizophrenia is tied to multiple genes, "a more complete picture of miRNAs may improve our understanding of the molecular mechanisms underlying schizophrenia," Tsai says.

Researcher's in the Tsai lab reprogrammed neurons from human cells of diseased patients, finding that microRNA-137 was increased. This was, in turn, tied to deficits in synaptic plasticity and cognitive dysfunction. Although schizophrenia is considered a disease of the synapse, nobody had ever shown that microRNAs could influence synaptic proteins directly. Reducing miRNA-137 results in improvements of synaptic transmission between neurons. These results suggest that manipulating miRNA-137 may have promising therapeutic effects.

Published in **Nature Neuroscience**.

The schizophrenia risk gene product miR-137 alters presynaptic plasticity. Sandra Siegert, Jinsoo Seo et al. Nature Neuroscience. May 25, 2015.

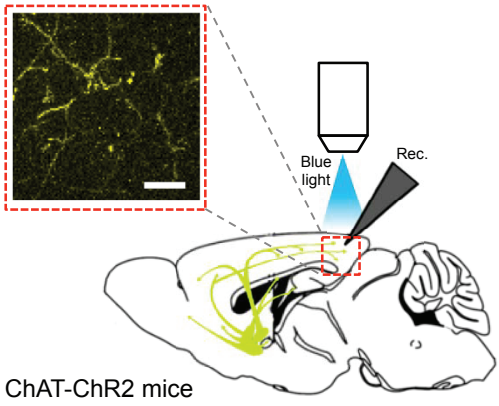
Desynchronize Your Brain for Better Attention

There are many scenarios in which being in sync is a good thing. The attentive brain, surprisingly, is not one of them.

Decorrelation–neurons firing in an unsynchronized manner–can enhance and even optimize information processing. In fact, conditions such as Parkinson's disease and epilepsy are characterized by pathologically synchronized neurons. **Mriganka Sur** and his lab pinpoint for the first time a specific subtype of inhibitory neuron that contributes to decorrelation in a major brain circuit tied to attention and arousal.

Picower Institute Professor Mriganka Sur

A fundamental feature of the awake, alert brain is the release of the neurotransmitter acetylcholine (ACh). By zeroing in on a specific cortical circuit driven by a single cell type, Sur demonstrates that a crucial function of ACh is to enhance information representation by acting principally on one class of inhibitory neuron in the cortex. Sur shows for the first time that a common neurotransmitter acts via this single type of neuron to enable the brain to process more effectively, pinpointing, in essence, the mechanism underlying a fundamental aspect of information representation in the brain.



Laser light is used to activate neurons that make up the visual cortex. The green neurons are turned on by the blue light (Inset) and can be visualized using microscope imaging. In parallel, recording electrodes (Rec) can be implanted around the same site to record the activity of these neurons.

Published in **Nature Neuroscience**.

An acetylcholine-activated microcircuit drives temporal dynamics of cortical activity. Naiyan Chen, Hiroki Sugihara & Mriganka Sur Nature Neuroscience. April 27, 2015

New Gift for the **Study of Aging**

The Glenn Foundation for Medical Research has pledged $2 million to establish the first collaborative center focused exclusively on researching the aging brain. The Paul F. Glenn Center for Science of Aging Research at MIT will leverage the discoveries of its predecessor lab bearing the same name, established at MIT in 2008 with a $5 million gift from the foundation.

The Glenn Foundation's generous gift will support the integration of multidisciplinary research initiatives in MIT's Picower Institute, Department of Biology, and Koch Institute for Integrative Cancer Research. This collaborative effort aligns directly with the recently announced MIT Aging Brain Initiative, aimed at executing urgently needed foundational research on Alzheimer's disease and other dementias to facilitate the comprehensive understanding of the aging brain required to prevent or delay the onset of these neurodegenerative conditions. As life expectancy rises and the population ages, these diseases now represent a global health crisis poised to bankrupt Medicare and impoverish healthcare systems worldwide unless breakthrough treatments are discovered.

Art of Thought

We are pleased to announce that Artist Todd Siler, who received his Ph.D. in Interdisciplinary Studies in Psychology and Art from MIT in 1986, has donated his experimental art installation entitled "Thought Assemblies" to the Picower Institute's permanent collection. This impressionistic artwork that interprets the structure of the brain, probing the neuropsychology of human thinking and creativity— including how people learn and remember—has found its perfect home in Picower's Terrace Reading Room. This generous gift from the Todd Lael Siler Charitable Remainder Trust and Ronald Feldman Fine Arts was first exhibited at the Musee D'Art Moderne in Paris in 1982. It later appeared in the MIT Museum's Margaret Hutchinson Compton Gallery and in the Boston Center for the Arts before arriving at its permanent home here at the Picower Institute.

Photo by Jeffery Wells Photography

Art by Todd Siler

Photo by Jeffery Wells Photography

The 8th Annual

Dana & Betty Fisher Retreat

In 2008, The Picower Institute received a generous endowment from the children of Dana and Betty Fisher to carry on the desire of their parents for furthering the knowledge of learning and memory. Their daughter, Wendy Fisher, selected the Picower Institute after learning about its mission of unlocking the brain's secrets and applying the knowledge to fighting psychiatric and neurological illnesses. The Fisher's generous gift affords the Picower community the rare opportunity to take a few days each year to build community and foster scientific interaction and collaboration.

On June 15th and 16th of this year, the faculty, post-docs, graduate students and staff of the Picower Institute gathered in North Falmouth, MA, for the 8th Annual Dana and Betty Fisher Retreat to present research from the past year and discuss ongoing projects. The event provides an informal environment where scientists can discuss ideas, start new collaborations, problem-solve, and build friendships. The history of science teaches us that major breakthroughs often emerge from collaborations among scientists with different types of expertise. The ideas behind many important discoveries at the Picower Institute can likely be traced back to discussions begun at the Dana and Betty Fisher retreats.

This year over 200 representatives from 12 laboratories participated. Anthony Grace, distinguished Professor of Neuroscience, Professor of Psychiatry and Psychology at the University of Pittsburgh gave the keynote address titled: "The circuitry of dopamine system regulation and its disruption in schizophrenia and depression". Each lab gave short 30-minute presentations over the two-day event and participated in a large poster session to interact one-on-one. Conversations, laughs and continued introductions took place over a clambake dinner and music entertainment by a scientist-led band.

With a broad range of scientific backgrounds, Picower scientists study the brain from molecule to mind. The Annual Dana and Betty Fisher Retreat is critical to the productivity of the neuroscientists at the Picower Institute and the Institute is thankful to the Fisher family for the tremendous support.

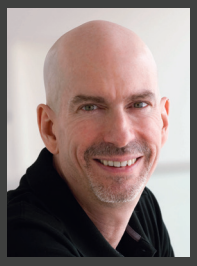
Highlights from the retreat on page 10.

Highlights from the retreat talks include:

- Research from **KAY TYE'S LABORATORY** showed that the amygdala, considered the fear center of the brain, can also process positive experiences.
- The **WEIFENG XU LAB** is exploring the function of a protein called neurogranin and it's importance in changing the communication between neurons. Interestingly, neurogranin is implicated in neurological disorder such as schizophrenia and Alzheimer's disease.
- **MARK BEAR'S LAB** presented on the effects inhibitory neural activity on visual perception and learning.
- The **KWANGHUN CHUNG LAB'S** described a new and innovative system called SWITCH. SWITCH is an elegant and straightforward way to preserve brain tissue for high power microscopic imaging.
  Research from Miriam Hyman's lab looks at the role of the PRC2 protein in making neurons vulnerable and it's relationship to Huntington's disease.
- Research from **MYRIAM HYMAN'S LAB** looks at the role of the PRC2 protein in making neurons vulnerable and it's relationship to Huntington's disease.
- The **TROY LITTLETON LAB** reported on a class of proteins called Shank and their effects on neuronal signaling. These proteins disrupt the development of proper neuronal communication.
- **MRIGANKA SUR'S LAB** presented on small bits of genetic code and how they orchestrate the genes important in neural development. The research from Sur's lab may provide greater understanding in those with Rett Syndrome, which results in physical and mental disabilities.
- The **SUSUMU TONEGAWA LAB** has found that when amnesia was induced in animals the seemingly lost memoires were not lost at all. The lab showed that the ability to access the memories was disrupted, not the memory itself.

PICOWER Accomplishments

MARK BEAR has been honored with the prestigious 2015 Neuronal Plasticity Prize of the Foundation IPSEN, awarded to researchers in recognition of outstanding contributions to the field of neuronal plasticity. Created in 1983 under the auspices of the Foundation de France, Fondation IPSEN fosters progress in biomedical research through recognition and support of fundamental advances. Bear is being recognized for his seminal work in genes, synapses and psychiatric disorders.



EARL MILLER has received a 2015 Professional Achievement Award from his undergraduate alma mater, Kent State University (KSU), at a special ceremony on October 2, 2015. The annual alumni awards recognize graduates who have made exceptional contributions in their chosen fields, in their communities, and at the university.

METTE RATHJE of Elly Nedivi's lab has won a Sapere Aude Award for Young Research Talent from the Danish Council of Independent Research, which recognizes elite researchers across every scientific field.

REBECCA CANTER of Li-Huei Tsai's lab and **LAURA STOPPEL** of Mark Bear's lab have been named MIT Graduate Women of Excellence for outstanding contributions to the MIT community.

LAURA STOPPEL of Bear Lab and **CAITLIN VANDER WEELE** of Tye Lab have received the Angus MacDonald Award for Excellence in Undergraduate Teaching (2015).

LEA HACHIGIAN of Heiman Lab received the Walle Nauta Award for Excellence in Graduate Teaching.

STEVEN RAMIREZ of Tonegawa Lab has been labeled as an ***Emerging Explorer by National Geographic***.

FRANCISCO X. PEÑA of Xu Lab and **ELIZABETH DE LAITTRE** of Bear Lab have received the Walle J.H. Nauta Award for Outstanding Research in Brain and Cognitive Sciences (2015).

REBECCA D. SHI of Xu Lab received the BCS Hans Lukas Teuber Award for Outstanding Academics (2015) and the Walle J.H. Nauta Award for Outstanding Research in Brain and Cognitive Sciences (2015).

Upcoming **Events**

For a list of ongoing scientific lectures, colloquia, and workshops, please go to: **picower.mit.edu**

Aging Brain Initiative

Dementias of aging like Alzheimer's disease now claim 35 million victims worldwide, with the numbers poised to double every 20 years. The annual cost-now estimated at US $604 billion — is growing faster than the number of sufferers. To date, no patient diagnosed with AD has ever recovered, and no effective disease-modifying therapies have been developed. MIT is building a major multidisciplinary, collaborative effort devoted to research on the aging brain with a goal of understanding how to reduce cognitive decline. The effort, called the Aging Brain Initiative aims to deliver tools, technologies, and pharmaceuticals into the clinical setting by encouraging varied perspectives and integrating core sciences across a wide range of fields. To find out more, please contact Dr. Asha Bhakar at **abhakar@mit.edu**.

As part of this effort, the Picower Institute, together with MIT's School of Science, host an **Aging Brain Seminar Series** every other month that is open to the public. We hope this event will stimulate fruitful and synergistic discussions for all those interested in learning about and collaborating on aging brain research.

Please join us for the following upcoming talks:

DR. PHIL DE JAGER, OCTOBER 28TH, 2015, 4 PM
Associate Professor of Neurology, Brigham and Women's Hospital

DR. BRADLEY HYMAN, JANUARY 28TH, 2016, 2 PM
Director of the Massachusetts Alzheimer's Disease Research Center, Professor of Neurology, Harvard Medical School

DR. MORGAN SHENG, MARCH 9TH, 2016, 2 PM
Genentech Vice President, Neuroscience & Molecular Biology

DR. DAVID BENNETT, MAY 10TH, 2016, 4 PM
Director of the Rush Alzheimer's Disease Center
Robert C. Borwell Professor of Neurological Sciences

NEW INSIGHTS ON EARLY LIFE STRESS AND MENTAL HEALTH

Picower Institute Spring Symposium, May 12th, 2016

Early childhood adversity and the debilitating effects it can have throughout life, is a global health problem and the repercussions are far reaching from physical to mental and societal and can include conditions like obesity, asthma, anxiety, addiction, and depression. On May 12th, 2016 the Picower Institute will host a symposium with clinical, community, and basic science talks—a bench to beside perspective—for a very informative conversation on the varied approaches taken and progress made for interventions to improve early life health.

THE PICOWER INSTITUTE
FOR LEARNING AND MEMORY

Massachusetts Institute of Technology
77 Massachusetts Avenue Building 46 Room 1303
Cambridge, MA 02139-4307
picower.mit.edu

Neuroscience News // Summer 2015

TOP ROW: **Mark F. Bear**, Picower Professor of Neuroscience, Department of Brain and Cognitive Sciences, Investigator, Howard Hughes Medical Institute (HHMI); **Kwanghun Chung**, Assistant Professor, Departments of Chemical Engineering and Brain and Cognitive Sciences. **Myriam Heiman**, Assistant Professor of Neuroscience, Department of Brain and Cognitive Sciences, Broad Institute core member; **Troy Littleton**, Picower Professor of Biology and Neuroscience, Departments of Biology and Brain and Cognitive Sciences.
MIDDLE ROW: Earl Miller, Picower Professor of Neuroscience, Department of Brain and Cognitive Sciences; **Elly Nedivi**, Professor, Departments of Brain and Cognitive Sciences and Biology;
Mriganka Sur, Paul E. Newton Professor of Neuroscience; Director of The Simons Center for the Social Brain; **Susumu Tonegawa**, Picower Professor of Biology and Neuroscience, Departments of Brain and Cognitive Sciences and Biology, Investigator, Howard Hughes Medical Institute, Investigator and Director of the RIKEN-MIT Center for Neural Circuit Genetics.
BOTTOM ROW: Li-Huei Tsai, Picower Professor of Neuroscience, Department of Brain and Cognitive Sciences, Director, The Picower Institute for Learning and Memory.
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