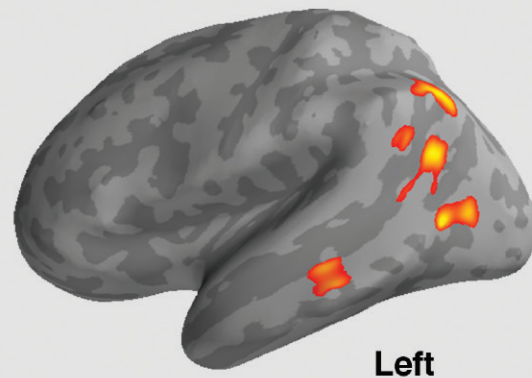
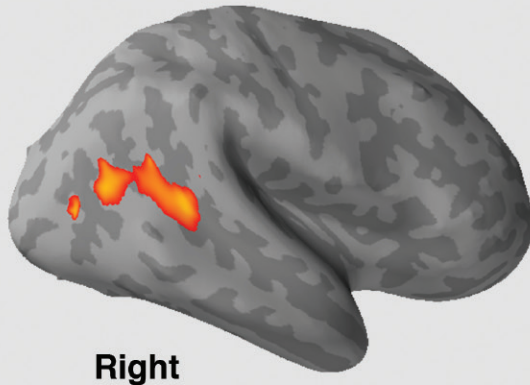
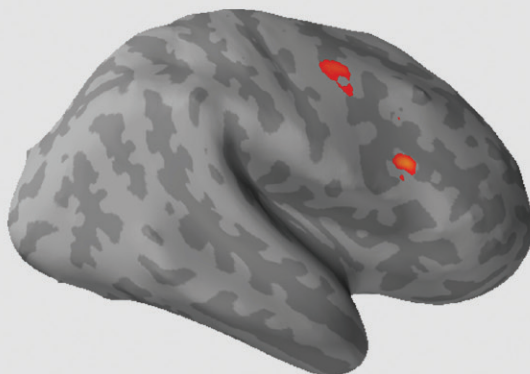


## Responding to Joint Attention > Solo Attention

Neuro-  
typical



ASD



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## A Message from the Department Head Jim DiCarlo

Since taking on the role of Department Head earlier this year, I have been focusing on the fundamentals: strengthening our community and our educational mission. This has given me new vantage points from which to learn about our community, which, like the fields we study, is constantly evolving in exciting ways. In this issue of our newsletter, you'll find several stories that highlight that evolution.

In our spring newsletter, I expressed my gratitude to our previous department Head, Mriganka Sur, who left the role to focus on creating the Simons Center for the Social Brain, the newest of the three research centers that have grown out of our department. In this issue we highlight the Simons Center, its mission, and its accomplishments so far. While there are researchers at many institutions studying autism and related disorders, the Simons Center is special because it focuses on what I believe we at MIT do best: establishing the basic science that will underlie future discoveries and treatments. The community that Mriganka is creating with the support of the Simons family has the potential to fill in the gaps in our basic understanding of the brain mechanisms that allow us to thrive in the social world.

Also in this issue we highlight the evolution of our Building 46 Postdoc Association. Postdoctoral fellows and associates are vital members of any research community, but they can often fall between the cracks as their departments focus on the needs of students and faculty. When I became Department Head I made a commitment to strengthen our community at all levels, so I was thrilled to work with postdoc leaders who share that goal. Their initiative has led to a building-wide Postdoc Association which will help to insure that our postdocs find maximal value in their MIT experience. I am particularly excited about helping to provide that community with a range of career building opportunities both inside and outside academia.

Our featured faculty-member for this issue is Kay Tye, who joined us earlier this year as an Assistant Professor in BCS and Investigator with the Picower Institute. This is especially exciting for me because I first got to know Kay as a budding scientist when she was an undergraduate in my Systems Neuroscience lab class (9.02). This spring, it will be my privilege to co-teach that lab course with her.

Kay is among the leading researchers in the systems neuroscience of circuits of motivated behavior, and she is dissecting those circuits using a wide range of cutting-edge techniques. Her journey from student to researcher and teacher exemplifies for me the potential for our educational mission and community to accelerate our research mission, and vice versa. Our careful attention to each of these missions, and to each person who plays a role in moving them forward, is what allows us to remain a cutting-edge and ever-evolving scientific community that is more than the sum of its parts.

Editorial Board  
Rachel Traughber  
Pia Handsom

Please keep  
in touch:  
bcs\_news@mit.edu

### On the Cover

Source – Hum Brain Mapp.  
2012 Apr 16. doi: 10.1002/  
hbm.22086. [Epub ahead of print]

Atypical brain activation patterns during a face-to-face joint attention game in adults with autism spectrum disorder.

Redcay E, Dodell-Feder D, Mavros PL, Kleiner M, Pearrow MJ, Triantafyllou C, Gabrieli JD, Saxe R.

Brain activation (fMRI) in young adults with typical development (top row) or autism spectrum disorders (bottom row) for live, face-to-face joint (shared) attention with another person via video while participant brains were being scanned relative to a condition when attention was not shared between the participant and the other person. Reduced activation in ASD group suggests possible failure of developmental neural specialization for joint attention.

Figure created by Elizabeth Redcay

## An Autism Research Community: The Simons Center for the Social Brain

Founded less than a year ago, the Simons Center for the Social Brain (SCSB) is well on its way to accomplishing its first goal: building an infrastructure for studying autism within the greater MIT community. Through several rounds of seed grants to faculty investigators, fellowships to postdoctoral researchers, and research awards to undergraduate students, the Center has assembled a group of scientists from a broad spectrum of MIT backgrounds, including the Department of Brain and Cognitive Sciences, the Department of Biology, the Department of Electrical Engineering and Computer Science and the Department of Mathematics. Each investigator brings his or her own unique expertise to the Simons Center's mission.

Seed grants and fellowships are only the beginning of SCSB's efforts to create an autism research community at MIT. Over the past few months, they have held poster events featuring autism related research by MIT scientists, created a monthly lunch series specifically focused on the social brain, and sponsored weekly coffee socials, all aimed at bringing researchers together to discuss their ideas. Their biweekly brain disorders colloquium series, started over five years ago, has become a centerpiece of the Boston autism community, attracting renowned researchers to MIT to present their latest findings.

SCSB Director Mriganka Sur sees the collaboration of scientists from diverse academic disciplines as one of the Center's foundational strengths, allowing its members to approach neuropsychiatric disorders from multiple points of view. "MIT has a broad range of researchers we can pull from" says Sur, "from engineering to neurobiology to cognition, and we are fortunate to have some of the best minds in the world at our disposal. You cannot solve a problem with the complexity of autism without this level and breadth of expertise."

### Mission

The mission of the Simons Center is to understand the neural mechanisms underlying social cognition and behavior, and to translate this knowledge into better diagnosis and treatment of autism spectrum disorders.

"Autism fundamentally affects social cognition. Humans have uniquely social capacities that are controlled in our brains by specific structures, created by evolution and development" explains Sur. "Our goal is to understand these structures, how they function, and what happens when their wiring goes wrong."

Autism is diagnosed in children and is a highly genetic disorder. The genes of autism are being rapidly discovered, and a major challenge is to translate genetic findings into an understanding of mechanisms responsible for changes in brain synapses and circuits. Another is to characterize the disorder carefully, and relate specific genes to specific symptoms. MIT, and SCSB, aims to lead this effort.

But without the generous support of long time MIT donors Jim and Marilyn Simons, this mission would not be possible. The Simons Foundation Autism Research Initiative helped found SCSB and is its partner.



Tomer Ullman, a graduate student in Josh Tenenbaum's laboratory, explains his research at SCSB's poster session on October 26

"Jim and Marilyn are very special - they are deeply engaged in the activities of the center, and in helping us implement its vision. This propels us forward even more towards our goal of understanding and treating disorders of brain development" says Sur.

### Next steps

SCSB's major goals over the next year focus on supporting and expanding the initiatives they have already begun, from seed grants, postdoctoral fellowships and UROP awards to the Simons Center colloquium series, all with the goal of developing and nurturing the brain disorders research community at MIT.

They also plan to initiate targeted projects based on two genetic mutations known to underlie specific forms of autism, bringing together the power of MIT's diverse scientific talent in a combined and concerted effort.

"In the manner that MIT developed RADAR in the Second World War - an achievement that not only won the war but also had wide impact on communication and information systems - we expect that this targeted effort will have broad impact on how we understand and treat brain disorders generally" explains Sur.

Indeed, research in MIT labs has led to clinical trials for two forms of autism. SCSB hopes to catalyze more such breakthroughs.

### Medical research and MIT – a potent combination

"People are often surprised that a university without a medical school is able to contribute so much to the study of brain disorders and diseases," says Sur, "but the truth is that brain disorders are not understood simply by studying their symptoms." By closely examining the biological workings of underlying brain structures, MIT scientists gain new insights into the causes and mechanisms of disorders of the mind.

"This is what MIT does very well, and I believe better than any other place: we think about fundamental processes and mechanisms," says Sur.

*For more information on the Simons Center for the Social Brain and their research initiatives, please visit their website at [web.mit.edu/scsb](http://web.mit.edu/scsb).* ■

## Faculty Profile: Kay Tye and the Tye Laboratory

**Want to know how the brain encodes good and bad associations to stimuli?** Ask BCS Assistant Professor Kay Tye.

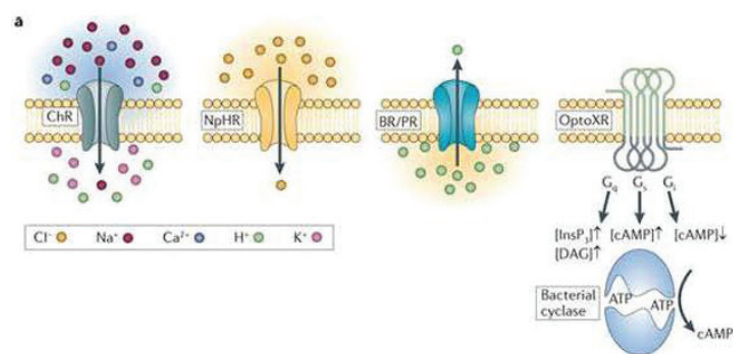
A car backfires near two women. One of the women immediately hits the ground covering her head with her hands, while the other continues blithely on her way, calmly chatting on her cell phone. It probably wouldn't be much of a challenge to guess which of these women was a recently returned veteran of the conflict in Iraq or Afghanistan. More difficult to assess is where in the human brain the circuits that identify the sound of a car backfiring as a threat or not actually diverge.

"It is surprising, considering how fundamental a question this is, that we still don't understand how we assign a positive or negative association," says newly minted BCS Assistant Professor Kay Tye.

For decades, it has been understood that plasticity in the section of the brain known as the amygdala controls fear conditioning, an organism's negatively conditioned response to a neutral stimulus. During her graduate work at UC San Francisco, Tye found that this same region and even the same synapses that changed in fear conditioning also changed after reward conditioning. This discovery led Tye to wonder how these same cells and pathways were able to support two such completely different reactions. "I think the answer is that all of these cells might not be the same," says Tye.

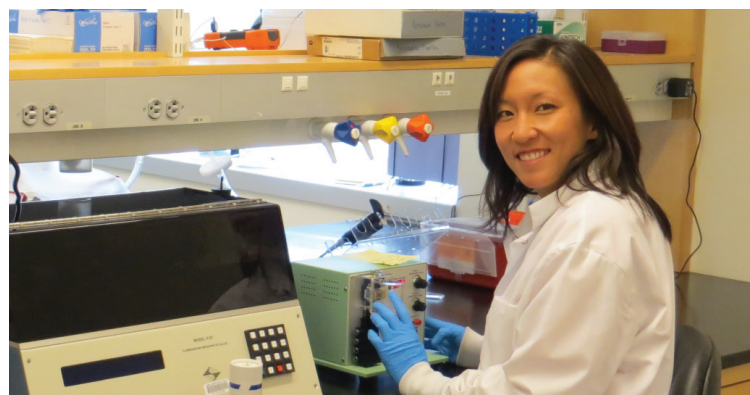
### Optogenetic projection specific targeting

The compelling nature of this question and its possible answers led Tye to a postdoctoral assignment at Stanford with Karl Deisseroth, where she was able to use optogenetic targeting to concentrate her efforts on these cells and mechanisms in the amygdala. Optogenetic targeting, a technology co-invented by Deisseroth and MIT Associate Professor Ed Boyden in 2005, uses photosensitivity to precisely control which cells activate when presented with various stimuli.



Major classes of single-component optogenetic tools include cation-permeable channels for membrane depolarization (such as channelrhodopsins (ChRs)), chloride pumps (for example, halorhodopsin (NpHR)) and proton pumps (such as bacteriorhodopsin or proteorhodopsin (BR/PR)) for membrane hyperpolarization, and light-activated membrane-bound G protein-coupled (OptoXR) or soluble (bacterial cyclase) receptors that mimic various signalling cascades.

By Rachel Traugher, BCS



Professor Kay Tye

"Optogenetics is a major advance," explains Tye. "It's genetically encodable and light sensitive, which means we can put it into any cell structure and get control down to the millisecond over neural activity."

In contrast to the nonspecific effects of electrical stimulation, which had previously been used to observe and create neural activity, optogenetics allows scientists ultimate control over their experimental target.

During her postdoctoral work, Tye was able to take this technique one step further by applying it to specific neural pathways. This advance opened up new areas of research examining the functionality of structures in the brain and how these structures are connected to behavior. In the course of her study, Tye discovered that activating specific pathways from the amygdala thought to be responsible for increasing anxiety instead resulted in lessening anxiety.

"Initially people had trouble wrapping their head around the idea that you can target specific [pathways] from a region and get the completely opposite effect from targeting all the neurons in the region," remarks Tye. She believes the answer to this puzzle lies in the variety and number of locations that the amygdala projects to in the brain.

According to Tye, "If you only target one [pathway], you're getting a very specific effect. If you target all of them, you get the cumulative effect of all the [pathways]." In the case of the pathway targeted in her postdoctoral study, Tye believes that its power to lessen anxiety is weaker than the effect of all the neurons in this section of the brain firing simultaneously. Her current line of research at BCS explores whether or not other individual pathways in the amygdala increase anxiety, a mirroring effect that occurs when the entire region is activated.

### Decoding valence encoding

Tye believes that unlocking the unique functional properties of these different pathways is the key to understanding valence encoding, or how we emotionally react positively or negatively to

continued on back cover



1.1 BCS graduate student **Rebecca Cantor**, **Norman B. Leventhal**. Photography by Julia Zhogina Photography

1.2 **Norman B. Leventhal and Alan Leventhal**. Photography by Julia Zhogina Photography

1.3 **Paul Marcus, Norman B. Leventhal, Anne Marcus**. Photography by Julia Zhogina Photography

2.1 From left to right, **Pia Handsom, Lisa Paul, Josh Kastorf, Annie Cardinaux, Rachel Traugher, Robert Cummings**.

3.1 **Dheeraj Roy and Shruti Gour**. Photography by Faith West.

4.1 **Noam Chomsky and Yarden Katz**. Photography by Graham Ramsay

## BCS Community News

### 1. Leventhal Student Fellowship Luncheon

On October 21, current and former **Norman B. Leventhal** Student Fellows attended a BCS sponsored luncheon celebrating the continuation of the Leventhal Fellowship program. The luncheon, which was attended by BCS benefactors Norman B. Leventhal, son Alan, and Paul and Anne Marcus, was an opportunity for the students to meet Mr. Leventhal, share their research, and express appreciation for their support over the years.

### 2. BCS welcomes new staff members

The Department is pleased to welcome new staff members **Annie Cardinaux**, Simons Center for the Social Brain Program Coordinator; **Robert Cummings**, BCS Graduate Program Assistant; **Lisa Paul**, BCS Laboratory Manager; **Pia Handsom**, BCS Administrative Officer; **Josh Kastorf**, Senior Administrative Assistant to Jim DiCarlo and **Rachel Traugher**, BCS Communications and Development Assistant. If you are in the neighborhood, please take a moment to stop by and say hi!

### 3. Congratulations!

BCS graduate student **Dheeraj Roy** married **Shruti Gour** in Philadelphia this summer.

### 4. An interview with Noam Chomsky

BCS graduate student **Yarden Katz** interviewed the famous linguist for *The Atlantic* this fall. Check out the article online on the *Atlantic's* website: <http://www.theatlantic.com>. For outtakes and video from the interview, take a moment to drop by Yarden's website: <http://web.mit.edu/yarden/www/chomsky/>

## A New Postdoc Initiative for Building 46

By Daniel Bendor, Katie Harris, Ethan Myers and Robert Komorowski

This fall, BCS Department Head Jim DiCarlo, Picower Director Li-Huei Tsai, McGovern Director Bob Desimone and Simons Center Director Mriganka Sur renewed their commitment to creating a strong and cohesive community of postdocs in building 46 by joining together to establish a building-wide postdoc association. The new association centralizes the administration of postdoc events and encourages collaboration across BCS, Picower, McGovern and Simons.

Key career-focused events included practice talks by senior postdocs who were preparing for faculty job interviews. The talks, dubbed “Chalk-Talks,” allowed these postdocs the opportunity to speak in front of a critical audience. Postdocs Jesse Goldberg, Jason Shepherd, Tim Buschman and Emily Osterweil bravely presented their future research plans in front of an audience of their peers and MIT faculty members, including Matt Wilson, Troy Littleton, Weifeng Xu, and Myriam Heiman.

The Building 46 Postdoctoral Association traces its roots to the Picower Institute’s postdoc committee. Four years ago, BCS Professor Mark Bear established the Picower Postdoc Committee as a postdoc-run initiative to improve collaboration between postdocs. The Picower committee organized social and academic events to strengthen the postdoc community, helped foster a cooperative environment, and encouraged collaborative research between postdocs. More recently, the Picower Institute provided a new lounge, complete with complimentary espresso machine, to create a new hub for postdoc interaction.

In addition to practice talks given by current postdocs, the committee hosted a Career Training Lecture Series that invited MIT faculty and staff, HST faculty, and speakers from local companies to share their wisdom on a variety of postdoc specific career related topics, from applying to jobs and starting a laboratory to balancing work and personal lives. The intersection between science and industry was a popular topic: talks in this area focused on issues of intellectual property, technology licensing, and how to launch start-ups. The most well attended sessions involved developing communication skills, from speaking well to writing grant proposals.

In cooperation with the Picower Institute, Desimone and former BCS Department Head Sur provided substantial support for initiating a series of career-related talks aimed at fostering professional development for the building 46 postdocs. With so many options for interaction stretching across building 46, interest in postdoctoral events and career training has steadily increased, making the evolution into a centralized committee structure a natural progression.

The Postdoc Committee also organized a K99 grant workshop with grant-writing advice from Dr. Jhaveri and Nina Gray, a Neuroscience Institute Program Manager at NYU, as well as a panel discussion with senior postdocs and junior faculty who had written successful K99s proposals. Included in the workshop were sample proposals written by BCS postdocs who were successfully funded.

Senior Research Scientist Sonal Jhaveri was named Director of Building 46 Postdoctoral Affairs. Dr. Jhaveri serves as a liaison between the postdocs, BCS Administrative Officer Pia Handsom, DiCarlo, and the three directors by helping to facilitate postdoc events and community building across the four constituencies.

Highlights of social events organized by the Postdoc Committee include Friday Socials on the 6th floor terrace, an evening at local Cambridge pub Meadhall, and an annual BBQ. To celebrate National Postdoc Appreciation Week, BCS, Picower, McGovern and Simons organized an Ice Cream Social for Building 46 postdocs.

### Talks, workshops and ice cream

During the 2011-2012 academic year, the Picower Postdoc Committee organized numerous events with a focus on career mentorship and social interactions within the postdoc community. The year began with a highly anticipated visit from Nobel laureates David Hubel and Torsten Wiesel, who reflected on their early explorations of the visual cortex and discussed new questions related to visual cortex plasticity and information processing. The committee also had regular “Sushi and Champagne” visits with leaders in neuroscience research: these events were attended by postdocs only and offered opportunities for relatively informal discussions about the leaders’ careers and research interests. This fall, the committee was excited to welcome Mike Ehlers, Chief Scientific Officer for Neuroscience Research at Pfizer, who discussed his views on the future of neuroscience research and drug discovery as well as his journey from academic scientist and HHMI investigator to CSO and Vice President of Pfizer.

### Upcoming

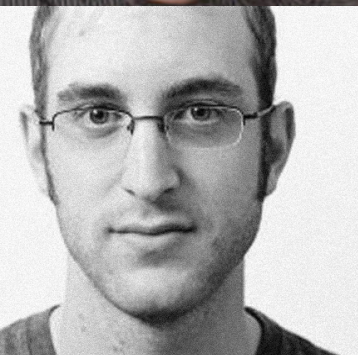
This coming year, with an increased budget made possible by combined support from the Picower Institute, McGovern Institute, the Simons Center and the Department of Brain and Cognitive Science, we are planning new initiatives that will help foster a rich training and social environment to assist in professional and personal development within the postdoctoral community. Our aims will be to provide venues for interaction between postdocs that will improve our working environment and increase collaboration, to organize events that promote career development and networking within academic and non-academic fields, and to act as a liaison between postdocs and the BCS/McGovern/Picower/Simons administration and faculty to advocate for policies that will improve benefits and the work environment. We will hold monthly meetings to help organize new events. All interested postdocs are invited to attend.

*For more information on joining the Postdoc association or their activities, please contact the Postdoc Committee’s current co-chairs: Ethan Meyers (emeyers@mit.edu) and Rob Komorowski (robkomo@mit.edu). ■*

## Noteworthy



Outgoing Postdoc Committee co-chairs Dan Bendor and Katie Harris



2012-2013 Postdoc Committee co-chairs Rob Komorowski and Ethan Meyers

### Faculty

**Emery Brown** and **Feng Zhang** have both been awarded “High Risk High Reward” grants from NIH for their innovative research programs. Brown will collaborate with **Matt Wilson** and **Ed Boyden**, as well as Dr. Ken Solt of MGH, to redesign general anesthesia. Zhang will probe neuropsychiatric diseases using targeted epigenome and genome engineering.

**Martha Constantine-Paton** has been awarded the Society for Neuroscience’s (SfN) **Mika Salpeter Lifetime Achievement Award**. The award recognizes individuals with outstanding career achievements in neuroscience who have also actively promoted the professional advancement of women in neuroscience.

**Sue Corkin** received the **Baltes Distinguished Research Achievement Award** from the Division on Adult Development and Aging of the American Psychological Association. This award recognizes distinguished careers and outstanding contributions to the psychological science of aging.

**Michale Fee** has been appointed as Associate Department Head of Education for BCS

**Ann Graybiel** has been selected for the **Kavli Prize in Neuroscience**. The prize, considered one of the highest in the field of neuroscience, is awarded for outstanding achievement in advancing knowledge and understanding of the brain and nervous system, including molecular neuroscience, cellular neuroscience, systems neuroscience, neurogenetics, developmental neuroscience, cognitive neuroscience, computational neuroscience and related facets of the brain and nervous system.

MIT President Emerita **Susan Hockfield** has been appointed **Marie Curie Visiting Professor** at the **Harvard Kennedy School**. She will be affiliated with the Belfer Center for Science and International Affairs, and will continue to serve as a Professor in BCS.

Our newest faculty-member, **Josh McDermott**, was selected for a **James S. McDonnell Foundation Scholar Award** in **Understanding Human Cognition**.

JSMF Scholar Awards support research studying how neural systems are linked to and support cognitive functions and how cognitive systems are related to an organism’s (preferably human) observable behavior.

**Pawan Sinha** was selected for a **Presidential Early Career Award for Scientists and Engineers (PECASE)**, the highest honor bestowed by the U.S. government on science and engineering professionals in the early stages of their independent research careers.

**Matt Wilson** has been appointed as Director of Graduate Education for BCS

The **Robert A. and Renee E. Belfer Family Foundation** announced that the **Picower Institute** will be one of three institutions that will join forces to create the **Neurodegeneration Consortium**, a transformative multi-institutional initiative that will advance the study and treatment of Alzheimer’s and other neurodegenerative diseases.

Prof. **Laura Schulz** has been appointed as **Undergraduate Officer** for BCS

### Students, Postdocs and Research Scientists

**Dr. Hu Dan** of Graybiel Lab has been selected for the **Infinite Mile Award** by the Office of the Provost. The award recognizes excellence in service to the MIT community.

BCS Postdoc **Kyle Smith** has accepted an assistantship at Dartmouth College beginning Fall 2013.

BCS graduate students **Dheeraj Roy** and **Yang Wu** were awarded MIT’s **Henry E. Singleton Presidential Fellowships** for 2012-2013.

**Caroline Runyan**, who graduated from BCS in June 2012, won the **BCS Outstanding Thesis Award** for her thesis “Distinct roles for inhibitory neuron subtypes in cortical circuits: An examination of their structure, function, and connectivity.”

continued from p.04

stimuli. Such understanding could potentially have wide ranging long term applications for the treatment of a variety of psychiatric diseases, including anxiety, addiction and depression.

“If you think about most psychiatric disease states that have been a mystery for a long time, they involve [disruptions] in normal valence encoding. In the case of anxiety, for example, you may have an imbalance in the amount of motivation you have to avoid potential threats and a reduced amount of motivation to seek out potential rewards, while an addict is overly motivated to seek out rewards, but maladaptively or pathologically unable to avoid potential negative consequences,” explains Tye.

The Tye Lab’s core mission has two main goals: To explore how our ability to encode emotional responses is connected at the cellular level and to discover whether or not there is commonality between these responses and different diseases of the mind. If a unifying thread could be drawn between addictive, depressive and anxiety behaviors and disorders, it would not only fundamentally change the way scientists research and collaborate on these diseases, but also the way these diseases are treated.

“People haven’t really explored the idea that there may be common, malfunctioning neural circuitry underlying multiple diseases,” said Tye. “If true, wouldn’t it be really helpful to be able to identify exactly where the problem is, so that you can treat that?”

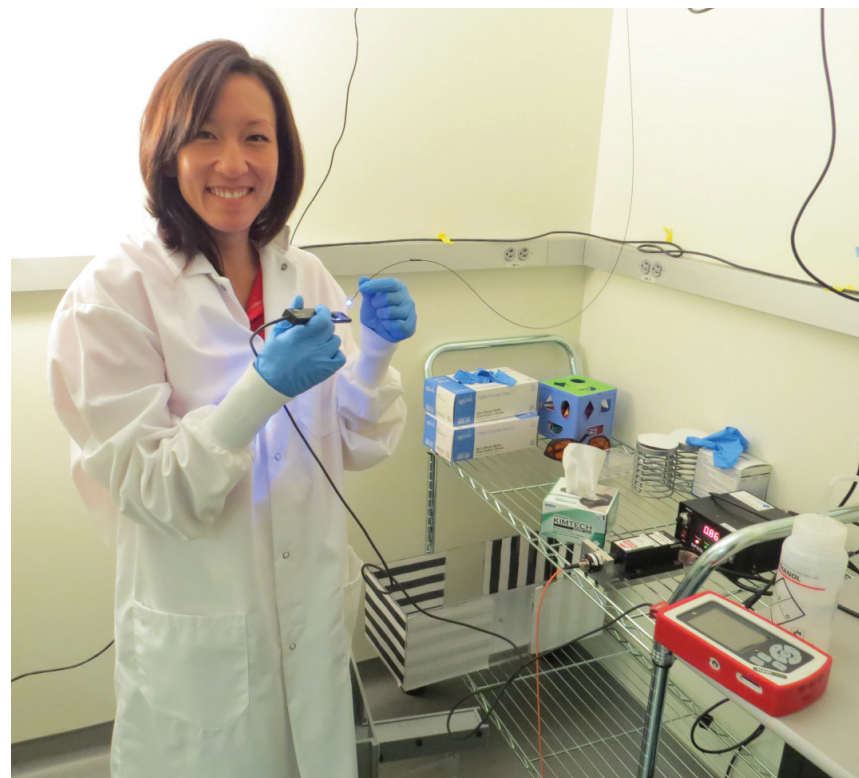
#### Why MIT BCS?

As an alumnus, Tye had first-hand experience with the interdisciplinary nature of the Department of Brain and Cognitive Sciences, and it was a major factor in her decision to return to her alma mater. Her research program, with its diverse range of methods and technologies, made the choice an easy one.

She looks forward to collaborating with such faculty as MIT Professors Matt Wilson, Li-Huei Tsai, Ed Boyden and the Department’s many talented students.

“The strength of having such a broad view is that you can look at the same, fundamental phenomenon from so many different vantage points that you can really see all of its dimensions and be really confident of what you’ve found. MIT truly supports this approach—I couldn’t imagine being anywhere else,” she explains.

*Assistant Professor Kay Tye is a faculty member of MIT’s Department of Brain and Cognitive Sciences and a Principle Investigator at the Picower Institute for Learning and Memory. For further information about her research interests or to contact her directly, please visit her laboratory’s website: [www.tyelab.org](http://www.tyelab.org)* ■



Professor Kay Tye