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**bc**snews

# *neurotransmitters*

 **brain+cognitive**  
sciences

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## A Message from the Department Head **Jim DiCarlo**

2016 has been a roller coaster year for the department — amidst the high thrills of science discovery and developing new scientists, we have the heartbreaking news of the passing of longtime colleagues. Indeed, as I write this letter, I have just received news that in addition to the passing of longtime professors Suzanne Corkin and Whitman Richards, who you will learn more about in this newsletter, former professor and department head Richard Held has also passed away. Their dedication and service to MIT and to science is something that I aim to emulate everyday. As a faculty member and educator, I consider it my privilege to pass on their dedication to the next generation of MIT brain and cognitive scientists. We should all aspire to similar heights.

As difficult as it has been, this year has also had moments of beauty and excitement. In this edition of the newsletter, you will learn about BCS graduate student Caitlin Vander Weele and her drive to see art in the science she completes at the microscope every day. Her perspective on finding the beauty in things that may not always go to plan is inspirational.

You will also meet new BCS Associate Professor Roger Levy. Levy joins us from the University of California San Diego's linguistics department, where he spent the last nine years as a faculty member leading the field of computational psycholinguistics — the model-based, experimentally grounded study of natural language processing and acquisition. We are very excited to welcome him to the department.

Last, as I am sure that many of you have heard, MIT launched a major campaign—The MIT Campaign for a Better World—emphasizing basic science as one of the Institute's priorities. Basic science is at the heart of the department's mission. We are motivated to answer fundamental questions of how the brain works because we know that this will surely impact the world with dramatic advances in science, medicine, technology, education, and government policies. While great progress has been made, our most important work is still ahead of us. I am confident that with the support our friends and alumni like you, we will continue to be a leader in innovative brain and cognitive sciences research. If you are interested in learning more about the campaign and the department's funding priorities, I encourage you to visit our website at [bcs.mit.edu/giving](https://bcs.mit.edu/giving).

### On the Cover

Neurotransmitters, the chemicals in our brain responsible for communication between neurons, affect their target cells by binding to receptors expressed on their membranes. Each neurotransmitter in the brain has a specific subset of receptors that is allowed to bind to and subsequently influence. DRDs: Neurons in the medial prefrontal cortex that express different types of dopamine receptors (D1 = red; D2 = green) and retrogradely labeled neurons (blue and pink).

Image courtesy of  
Caitlin Vander Weele, Tye laboratory

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# Interstellate: A Collection of Thoughts

BCS graduate student Caitlin Vander Weele launches collaborative neuro-art pictorial magazine

By Rachel Traugher | BCS Communications

“Scientists take beautiful images of the brain every day, and for the most part no one gets to see them. Experiments fail all the time and the images just get buried. People don’t really get to see that side of science,” says BCS graduate student Caitlin Vander Weele. “At the end of the day, they aren’t really failed experiments. They help us generate better methods and come up with better hypotheses.”

A 5th year graduate student in Assistant Professor Kay Tye’s lab, Vander Weele recently launched *Interstellate*, a neuro-art pictorial magazine, to share these images with the world.

The idea for creating the magazine evolved through social media.

“I started tweeting images out and people gravitated towards them, both scientists and non-scientists,” says Vander Weele. “It occurred to me that using these kind of images might be really useful for science outreach and communication.”

Vander Weele had already begun to create a visual thesis of her work in the Tye lab to help explain her research at MIT to non-scientist friends and family. Expanding on that idea, she eventually collected between 150-200 images from 69 scientists in nine different countries.

“I was very surprised at how enthusiastic people were about the project. At the end of the day, you’re sharing data, and not everyone is comfortable doing that,” explains Vander Weele.

The magazine’s brilliantly colored images span the regions of the brain and include everything from individual neurons to clusters of cells, brain slices, and in one image, an entire rat brain. The broad range of colors and techniques used showcase the variety of ways that scientists are able to label different kinds of neurons and processes in the brain for study.

“Imagine you have a whole bunch of different types of noodles packed into a baseball, and you want to find the spaghetti. This is basically the same problem encountered by scientists wanting to target only a small number of cells in the brain. How do you do that? One way is to create a transgenic animal capable of expressing a fluorescent protein in a specific cell type that you want. When you slice the brain and look at it under a microscope, these neurons

actually glow. Another way is a viral approach that enables us to insert modified DNA sequences that express a gene of interest, such as one that emits a fluorescent signal. You inject this virus into a brain region of interest and based on how it is designed, it will express your fluorescent protein only in specific cell types,” explains Vander Weele.

These techniques are part of the reason that Vander Weele came to MIT for graduate work. Originally from Frankenmuth, MI, her research in the Tye lab uses cutting edge tools, including optogenetics and *in vivo* calcium imaging. She was particularly interested in manipulating communication between different brain regions which share information about what is good and bad in our environment.

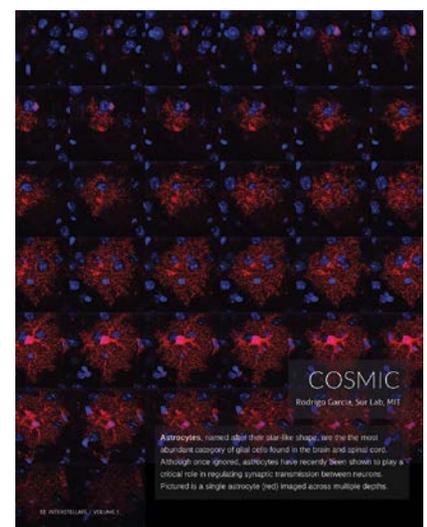
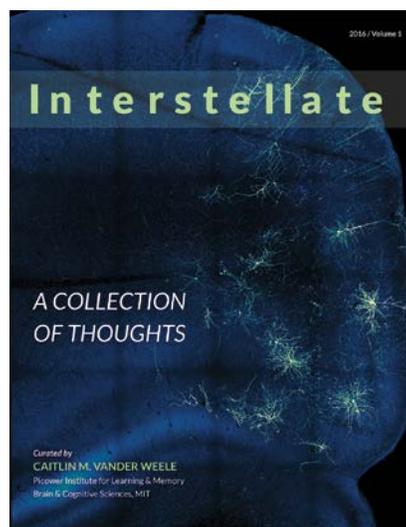
“When I was doing research as an undergraduate, scientists really didn’t have the tools to specifically manipulate connections *between* brain regions. We would lesion an area, or cause damage to it, or use electrical methods that weren’t very specific. MIT was leading the way in a lot of research that allowed us to precisely target a projection’s pathways in the brain and manipulate them. It was incredibly exciting.”

With so many images to choose from, selecting those that would be included in the magazine was a difficult choice. Volume two of *Interstellate* is already in the works, with new images being submitted weekly.

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BCS graduate student  
Caitlin Vander Weele



A page from *Interstellate* featuring BCS graduate alum Rodrigo Garcia’s work in the Sur laboratory

# Department Mourns Loss of Longtime Faculty Members

Suzanne Corkin and Whitman Richards had combined 110 years of dedicated service to MIT



BCS Professor Emerita  
Suzanne Corkin

## Suzanne Corkin

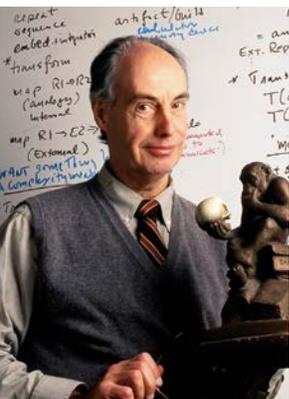
Suzanne Hammond Corkin, Professor of Neuroscience Emerita in the Department of Brain and Cognitive Sciences at MIT, died of liver cancer on May 24, 2016. Corkin received her PhD from McGill University in 1964 under the tutelage of Dr. Brenda Milner. Her research during her 51-year career at MIT focused on the study of patients with neurological disease, with the goal of linking specific cognitive processes, particularly memory, to discrete brain circuits. She was well known for her investigation of the famous amnesic patient, H.M., whom she met in 1962 and studied until his death in 2008.

Corkin also described the long-term consequences of head injury in World War II and Korean War veterans, and the safety and efficacy of a psychosurgical procedure, cingulotomy, in patients with medication resistant psychiatric disease. Her subsequent research focused on the neural underpinnings of age-related degenerative diseases, including Alzheimer's and Parkinson's. She and her colleagues developed behavioral tasks that elucidated the nature and severity of individual Parkinson and Alzheimer patients' cognitive and psychiatric deficits, and innovative neuroanatomical labeling tools for visualizing brain regions that are targeted by PD or AD pathophysiology.

The recipient of numerous awards, Corkin was especially proud to receive the Brain and Cognitive Sciences Undergraduate Advising Award at MIT in 2011. She was a freshman advisor for 17 years, and served on several Institute and Departmental committees.

On May 18, 2016 she had a joyful celebration of her 79th birthday in the company of family, friends, and her beloved dog Trooper, whom she rescued from the streets of Ecuador. In keeping with her commitment to understanding memory and other aspects of brain function, Corkin arranged for her brain to be donated for research.

*Corkin is survived by beloved sons J. Zachary Corkin II; Damon Lester Corkin and his wife Angela Adriana Veliz-Corkin; daughter Jocelyn Hammond Corkin and her husband Peter Mortimer; and adored grandchildren Charles Corkin III, Colette Sage Corkin, Wesley Donald Corkin, Pia Frances Corkin Mortimer, Xavier Charles Corkin Mortimer, Olivia Suzanne Corkin, and Stella Paz Corkin. Gifts in Corkin's memory may be made to MIT to support minority women students in science (contact: bonnyk@mit.edu), to the Angell Animal Medical Center in Boston (under "designated giving" at <https://www.mspca.org/donate-now/>), or to Grassroots Wildlife Conservation (<http://www.grassrootswildlife.org/>).*



BCS Professor Emeritus  
Whitman Richards

Photo: Webb Chappell MIT Media Lab

## Whitman Richards

Whitman Richards, Professor Emeritus of Cognitive Sciences and Media Arts and Sciences, and Principal Investigator in the Computer Science and Artificial Intelligence Laboratory, died on September 16th after a long battle with myelofibrosis. One of the first four Ph.D. graduates of the Department of Brain and Cognitive Sciences (BCS), his more than 60 years at MIT were marked by a dedication to the experimental and theoretical study of vision, perception, and cognition.

Richards began his affiliation with MIT as an undergraduate, matriculating in 1950. His decision to return to MIT for graduate work (Ph.D '65) was greatly inspired by a meeting with BCS founder and then department head Professor Hans-Lukas Teuber.

"In the 1960's, with the advent of accessible computer technology, the development of information theory, and the single electrode, there was renewed excitement about prospects for modeling and understanding mind and brain," said Richards in a 2004 MIT interview. "Teuber's charisma and broad vision for a new psychol-ogy was a

powerful draw [to the department]. ...There was a unique opportunity for a non-traditional grounding in a discipline otherwise mired in tradition."

Richards' early research pursued traditional psychophysical experimental methods to study the mechanisms of color perception and stereovision. In the 1970s, his research direction and methodology shifted dramatically after meeting noted physiologist David Marr, who he eventually recruited to MIT. Instead of relying on the traditional experimental methods that had characterized his early career, Richards, Marr, and colleagues began to look for the deep, underlying mathematical principles that allowed a human or artificial visual system to look at the world and make accurate inferences about what the system saw or perceived.

"The breadth of his research was really quite remarkable," says MIT Professor of Computational Cognitive Science and former Richards graduate student Josh Tenenbaum. "As his career developed, he transitioned from studying the parts of vision that are very close to

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# BCS Community News



## BCS students complete service projects abroad

*Support from MIT's Priscilla King Gray Public Service Center enabled students to work on capacity-building projects*

Cailey Talbot '19 spent nine weeks in Uganda helping develop the health of Jinja, specifically working on support for HIV positive mothers in efforts to increase treatment adherence and help prevent vertical transmission of HIV (mother to child). She interned at the Iganga Islamic Medical Center in the maternal and antenatal unit of the clinic. There, Cailey was involved in the screening, vaccination, and treatment of patients. With the help of the Counseling Center, Cailey helped create a support group for the HIV positive mothers and also initiated an incentivizing chicken project within the group. Each mother was given a few chickens to raise, breed, and sell in order to increase the mothers' nutritional and financial support.

Graduate student Tuan Le Mau spent his summer in Vietnam and Boston to grow his Dream Project Incubator (DPI) program. Each year, DPI brings five fellows from Vietnam to Boston to learn from mentors and plug themselves into the Boston ecosystem to seek resources to grow and own dream project. With PKG center support, Tuan canvassed support from corporate sponsors and increased the reach of DPI program in Vietnam.

**1** Le Mau leads a weekly reflection session for DPI fellows during their immersion trip in Boston.

**2** Talbot with Mothers of the Support Group

## Longtime BCS staff member retires

Dr. Sonal Jhaveri retired from MIT this summer. Sonal began her decades long career with BCS as an undergraduate student, graduating in 1970 with a degree in Physics. She then pursued her masters in psychology here in BCS, graduating in 1973. In 1978 she received her Ph.D. in anatomy from Harvard University and continued on with her postdoc in neurobiology at Harvard Medical School. In 1982 Sonal was appointed as a Research Scientist in BCS and during her tenancy received promotions to Principal Research Scientist and Sr. Research Scientist where she focused her studies on the neural pattern formation and regeneration during development, after brain damage, with transplantations, or following genetic alterations. Most recently, Sonal served our community as Director of Postdoctoral Affairs in Building 46 where she was an active ear and voice for the postdoc community and has been instrumental in many of the recent improvements within the postdoc community. While Sonal may be stepping down, her contributions will continue to impact our department well into the future. Her research, education, service, and dedication over the years has been invaluable, and she will be greatly missed.

**3** Dr. Sonal Jhaveri

## Joint retreat in Newport, RI

The second BCS, Picower and McGovern Institute joint retreat was held in June 2016. Featuring talks from members of all three units, the two-day event also included a poster session, New England clam bake, and a dance party!

**4** Retreat attendees 2016

## Department Welcomes New Associate Professor

Roger Levy studies the foundational architecture of human language processing and acquisition

### **BCSN: Share a little bit about your research.**

**Levy:** Human language is the most expressive communication system in the known universe. Hundreds of times a day, we say sentences that we've never said or heard before to express novel meanings, and we hear and read hundreds more sentences we've never encountered before and understand what they mean. We're able to do this in real time, despite a number of competing factors – limitations on our memory and attention, a noisy environment, the rampant intrinsic ambiguity of language itself, and our incomplete knowledge of the people we speak and listen to and whose texts we read. Compare this, for example, with the state of the art in computer understanding of human language: even if you speak right into your phone and Siri is able to make out your words correctly, its understanding of what you say and consequently to translate your commands into actions remains incredibly limited and superficial. Cast in this light, our ability to communicate effectively with language is all the more extraordinary.

This ability immediately raises some very deep questions about how the human mind works. How is it that we are able to understand each other? How is our system for communication structured? How are we able to learn this system from the input that we get as children? We go far beyond the raw content that we get as children to be able to generate novel utterances and understand them. Our powers of acquisition are remarkable.

To study our uniquely human capability to acquire and use language, I combine computational modeling with psycholinguistic experimentation, ideas from linguistic theory, and analysis of naturalistic language data sets. I try to understand the statistical and structure properties of language as people actually use it on an everyday basis, and also how linguistic knowledge can be adaptively

deployed in novel and unusual contexts to achieve a variety of communicative goals. Using all of these things together, I hope to understand more about how we process and acquire language.

### **BCSN: What drew you to MIT?**

**Levy:** It was an offer that I couldn't refuse. For the kind of work that I do, combining computational modeling, experimentation, large data set analysis, and rich theory development that I practice in my research, the graduate program here is the strongest in the world, and the overall community is unparalleled.

### **BCSN: What do you look for in grad students?**

**Levy:** For me, the signature quality that makes a grad student stand out is the drive to build their own theory of the domain that they want to work in - having a very specific perspective that is theirs and that they want to develop. Their graduate training gives them practice at developing that perspective and bringing it to bear in studying problems by asking questions that are both important and tractable. The very hardest thing in science is figuring out what questions to ask – everything else follows from there.

At a more nuts-and-bolts level, I also look for technical skills such as proficiency in mathematics, being able to work well with computers, coding, good communication and teamwork skills, enthusiasm for studying language, and a deep interest in the human mind.

### **BCSN: What excites you most about the next five years?**

**Levy:** I'm very excited about extending the scope of my research program. Now that I'm in a department where brain and cognitive sciences are studied together, I'm particularly hopeful that we will discover new ways of interfacing my computational and behavioral work with any of a variety of techniques in neuroscience to deepen our understanding of the neural basis of cognition and language comprehension. This is the best possible environment for doing that, and I hope that organic collaborations will develop, allowing my skills and expertise to complement existing efforts to study the brain basis of language. ■■

BCS Associate Professor Roger Levy




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Learn more about Levy's research at [bcs.mit.edu/levy](https://bcs.mit.edu/levy)

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## Noteworthy News

### The department congratulates our new graduates:

**PhD** Stephen Allsop, Wilma Bainbridge, Leon Bergen, Rodrigo Garcia, Matthew Greene, Julian Jara-Ettinger, Joseph Keller, Kyle Mahowald, Nune Martiros, Praneeth Namburi, Horng-An Nieh, and Rachel Schechter **SB** Sylvia Atsaves, Alexandra Burgess, Bingchi Cao, Briana Chen, Jean Chow, Veronica Chu, Michaela Ennis, Catherine Garrison, Priyanka Gaur, Sophie Geoghan, Kathryn Hanling, David Jin, Eva-Lotta Kasper, Jillian Katz, Margaret Lattanzi-Silveus, Alexander Lim, Riana Lo Bu, Alice Lu, Eduardo Maury, Catherine Potter, Kara Presbrey, Abra Shen, Priyanka Shome, Patience Stevens, Maximilian Tang, Cordelia Tuan, Danil Tyulmankov, Xueyin Wen, Samantha Williams, and Ariella Yosafat.

### Awards and Honors

Postdoc **Rose Faghih** was recognized as one of the **2016 New Faces of Engineering** by DiscoverE. The award honors the work of up-and-coming engineers who are making their mark on their industry.

**Guoping Feng** received the **BCS Award for Excellence in Graduate Mentoring**.

**John Gabrieli** was elected to the **American Academy of Arts and Sciences**. He also received the **BCS Award for Excellence in Undergraduate Teaching**, and the **BCS Postdoc Award to an Outstanding Mentor**.

**Mehrdad Jazayeri** received the **BCS Award for Excellence in Graduate Teaching**.

**Earl Miller** received the **Kent State University Professional Achievement Award**. He was also their commencement speaker.

**Pawan Sinha** received the **BCS Award for Excellence in Undergraduate Advising**.

**Josh Tenenbaum** was selected to receive the **2016 Howard Crosby Warren Medal** from the Society of Experimental Psychologists. This is the oldest award in psychology, with a distinguished history dating back to 1936.

**Jean-Jacques Slotine** received the **2016 Rufus Oldenburger Medal**. Given by the American Society of Mechanical Engineers, the medal recognizes significant contributions and outstanding achievements in the field of automatic control.

**Kay Tye** received a **Presidential Early Career Award**. Coordinated by the Office of Science and Technology Policy within the Executive Office of the President, awardees are selected for their pursuit of innovative research at the frontiers of science and technology and their commitment to community service as demonstrated through scientific leadership, public education, or community outreach. She also received the **Harold E. Edgerton Faculty Achievement Award**. The award recognizes exceptional distinction in teaching, research, and scholarship, and is given annually to one individual from among the junior members of the MIT faculty.

**Shimon Ullman** was elected to the **American Academy of Arts and Sciences**.

**Feng Zhang** received a **Canada Gairdner International Award** for his work on CRISPR. Created in 1959, the awards are given annually to recognize and reward the achievements of medical researchers whose work contributes significantly to the understanding of human biology and disease.

The building 46 team that entered the MIT Crossing the Charles parade competition won the DaVinci Award for Creativity and Wonder for their giant brain float.

The following people have received **School of Science Spot Awards: Federico Chiavazza and Julianne Gale**. Spot Awards are intended to acknowledge and demonstrate appreciation and recognition for the exceptional contributions of individuals and teams, large or small.

BCS undergraduates **Veronica Chu, Michaela Ennis, Kathryn Hanling, Alice Lu, Eduardo Maury, Kara Presbrey, Abra Shen, Caitlin Tan, and Xueyin Wen** were invited into the XI Chapter of Phi Beta Kappa.

BCS graduate students **Lea Hachigian, Chen Sun, Kelsey Allen, David Scott, Richard Futrell, Christopher Leppla, Michael Reed, Joshua Rule, Max Kleiman-Weiner** won the **Angus MacDonald Award for Excellence in Undergraduate Teaching**.

BCS graduate students **Hannah Iaccarino and Chia-Jung Chang** won the **Walle Nauta Award for Excellence in Graduate Teaching**.

BCS graduate students **Idan Blank and Wilma Bainbridge** won the **Walle Nauta Awards for Continuing Dedication to Teaching**.

continued from p.3

"My plan is to do one, maybe two more editions before passing the magazine on to someone else. It's been a fantastic hobby: I'm interested in it, I've learned a lot through it, and I think that someone else could really benefit from working on it, as well."

*Want to learn more or get your own copy of Interstellate? Follow Interstellate on Twitter @Interstellate\_ or visit the magazine's website at [http://pub.lucidpress.com/Interstellate\\_Volume1/](http://pub.lucidpress.com/Interstellate_Volume1/).* ■■



Vander Weele constructs an optical fiber for in vivo manipulations of brain circuits using optogenetic approaches.

continued from p.4

neural mechanisms, to computational representations of perception, to Bayesian statistical models of perception and cognition. He became almost a computational social scientist - he was incredibly flexible in his thinking."

Richards' passionate advocacy for the computational approach to studying visual perception helped to create and nurture the department's early computational research initiatives.

"Whit's connection with David Marr back in the late '70s is really the genesis of modern computational social science today," says MIT Professor Alex Pentland, Toshiba Professor of Media Arts & Science and former Richards graduate student.

Alongside his impressive research legacy, which includes the publication of eight books and over 200 articles, he was also regarded by his students and colleagues as a superlative mentor. Many of his former students have found success in a variety of different fields, including psychology, cognitive science, computer science, media, computer graphics, and the defense industry.

"Whitman was an incredibly dedicated advisor. His strategy was to have very few students and make a huge personal investment in each of them," says John Rubin, a former graduate student of Richards and current executive producer with Tangled Bank Studios at the Howard Hughes Medical Institute. "He was really great at keeping enthusiasm high in his lab, which took all kinds of forms, but included croquet parties at his home, which were terrifically fun. He was always available and in fact it was hard for me to keep up with the amount of time he wanted to devote to our joint work! He was indefatigable and devoted."

*Richards is survived by his wife of 54 years, Waltraud Weller Richards, and three daughters: Diana Richards Doyle and husband Mark S. Doyle of Green Cove Springs, FL; Sylvia Richards-Gerngross and husband Tillman Gerngross of Hanover, NH; and Eleanor "Nora" Richards Bender and husband Thomas A. Bender of Dedham, MA. He is also survived by his two siblings: Lincoln K. Richards and wife Gerda of Wellesley, MA, and Sylvia Richards Messner of Cave Creek, AZ; and by two grandchildren, Morgan Kelly Doyle and Serafina Richards-Gerngross. Memorial services will be private.* ■■