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50

brain+cognitive sciences

50th anniversary

A Message from the Department Head Jim DiCarlo



2015 marked the 50th anniversary year of the department's graduate program. In 1964, Hans-Lukas Teuber founded the Department of Psychology at MIT with the then-radical vision that the study of brain and mind are inseparable. The department was conceptualized as an interdisciplinary nexus covering multiple levels of analysis with the end goal of understanding how the brain gives rise to the mind. Today, BCS continues to shape the frontiers of the rapidly evolving fields of molecular and cellular neuroscience, systems neuroscience, cognitive science, computation, and cognitive neuroscience.

To celebrate this milestone, we hosted a three hour reception on campus highlighting the department's many scientific contributions over the years. For those of you who were unable to join us in person, I hope that this special, longer edition of our biannual newsletter will allow you to experience a snapshot of a very exciting event in building 46.

As I read through this issue, I am reminded of the wonderful legacy our past students, faculty, staff and researchers have left behind and am inspired by those here presently carrying forward that excellence into the future. We may have the chance – within our lifetimes – to uncover answers to some of the biggest questions about how the brain gives rise to the mind. The technology now being created within the MIT campus offers us so many opportunities to refine our study of the brain and mind in ways we could not have begun to imagine even 15 years ago.

Great progress has been made. The brain is the next frontier. We have an opportunity to seize this moment and, perhaps, to change human history.

We are honored and excited to be part of it all.

Editorial Board
Rachel Traughber
Pia Handsom

Please keep in touch:
bcs_news@mit.edu

Pictured here is the hippocampus and the cells within it processing a particular memory. The cells glowing in red have processed the memory of an aversive environment and have been genetically engineered to turn on with just brief pulses of light, thereby reactivating the memory of the environment itself.

Image courtesy of Steve Ramirez, Tonegawa Laboratory.



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50 Years of Brain and Cognitive Sciences

Department celebrates a half-century of innovative research

By Rachel Traughber, BCS

On June 3, 2015, the Department of Brain and Cognitive Sciences celebrated its 50th anniversary. Alumni and supporters, alongside current students, faculty, staff, and researchers were welcomed to campus for a three hour brain and cognitive sciences community event featuring exhibits from the past, present, and future of the department's research.

A committee of department members led by chair BCS Professor Emerita Sue Corkin organized the festivities. "During the preceding months, we tracked down and invited alumni, staff, faculty, and students who had been part of our community over the years. It was very important that this celebration represent the brain and cognitive sciences community as a whole," explained Corkin. "The outpouring of support was tremendous, and BCS staff deserve accolades for contributing ideas and implementing every detail of the successful celebration."

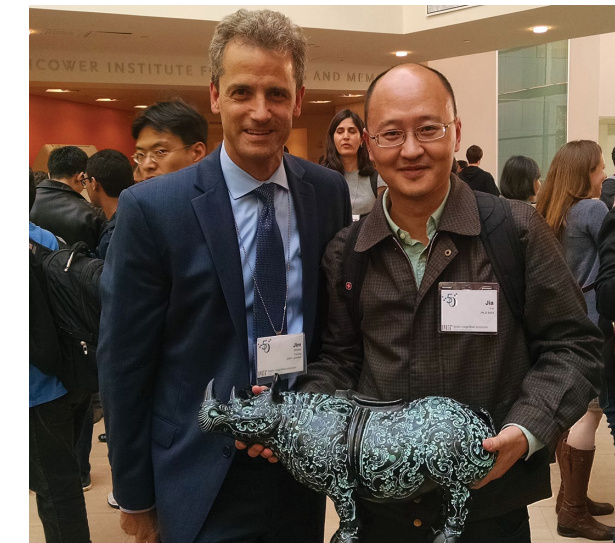
The evening kicked off with an introduction from department head Jim DiCarlo. "I was absolutely thrilled to welcome so many department alumni and friends to our celebration," said DiCarlo, "we had a fantastic turnout from across the MIT campus and the world."

In celebration of the anniversary, the department commissioned a documentary film "From Mind to Brain: The Story of Brain and Cognitive Sciences at MIT" about the genesis of brain and cognitive sciences at MIT. The film interviewed BCS faculty members from the last 50 years about their experiences in the department. Guests were also invited to take part in a commemorative 50th anniversary mosaic. Each guest was able to design their own personal tile that will be compiled into a large, group artwork and displayed prominently in building 46.

Unable to attend the celebration in June? Visit bcs50.mit.edu for more information, including the commemorative documentary video, "From Mind to Brain."



Professor Emerita Sue Corkin led the committee that planned the celebration.



BCS alumnus Jia Liu PhD '03 presents department head Jim DiCarlo with a statue commemorating the department's 50th anniversary. The statue was gifted on behalf of Beijing Normal University, where Liu is currently department head of psychology.



Party guests show off their mosaic tiles.



Postdocs enjoying the event's signature drink, the Brain Storm, served from a large brain ice sculpture.



Matt Wilson greets guest during event reception.



David Cohen, the inventor of MEG, sharing his technology with guests.



Aviad Hai from the Jasanoff laboratory demonstrates nanotechnology in the Future room.



Steven Pinker, Peter Schiller, and others enjoying a display in the Past room.



The event reception took place in the building 46 atrium.

The Department's Founders

History and first person recollections of Hans-Lukas Teuber, Richard Held, and Walle Nauta

by BCS faculty members Sue Corkin, Peter Schiller, and Gerry Schneider

Hans-Lukas Teuber

Hans-Lukas Teuber (1916-1977) founded MIT's Department of Psychology, which evolved into the Department of Brain and Cognitive Sciences. Teuber was one of the most influential neuropsychologists of his generation, and his vision for the MIT department was a major influence on the establishment of neuroscience as a field. He died at age 61 in a swimming accident in the British Virgin Islands.



Hans-Lukas Teuber in 1961, newly installed as Head of the Psychology Section at MIT.



Lukas in his MIT office in 1976, in building E10.

Teuber came to MIT from NYU's Bellevue Medical Center in 1960 as head of a section of the Department of Economics and Social Science. In the first year, this section occupied shared space in a building that had been constructed for World War II related research and development (Building 20, no longer existing). The small group of experimental psychologists already in the section did minimal teaching and offered no graduate program. Within a few years, all the members of the old guard departed, and Teuber himself began teaching an undergraduate class, Introduction to Psychology—experimental psychology as he envisioned it. Teuber was an amazingly popular lecturer with infectious enthusiasm for the field, an ability to relate to young people, and jokes that were too good to miss.

Two senior appointments in the early years were completely novel for a psychology department: one of the most distinguished systems neuroanatomists at that time—Walle J.H. Nauta—and a single-neuron physiologist—Emilio Bizzi. Another novelty for a university without a medical school was his spearheading the establishment, in 1964, of a Clinical Research Center for the study of neurological patients and for other kinds of clinical research. MIT's CRC was the first federally funded center of this nature to be established outside of a hospital or medical school. The same year, Suzanne Corkin received her PhD under Brenda Milner at McGill University, and Teuber hired her as a Research Scientist

to establish a neuropsychology laboratory at the CRC and conduct investigations of neurological patients. Corkin later joined the faculty of the Psychology Department. Lukas was a major figure at scientific meetings, often organizing them, and he was a popular “wrap-up” speaker at the end of symposia because of his extraordinary ability to synthesize a series of presentations with the key points made by each speaker, integrated to form an exciting story enhanced by his provocative generalizations. He often gave talks throughout the country and the world, publicizing the research in the labs of his department and making his faculty and their discoveries widely known. Lukas and his faculty invited many distinguished investigators to speak at departmental colloquia on Friday afternoons.



Teuber giving a talk in Lyon, France, when he received an honorary degree in 1975, speaking about and illustrating a discovery in one of the labs in his MIT department. His enthusiasm for the work of his faculty was boundless.

After the post-colloquium discussions, Lukas would take the speaker to his house for a dinner party, preceded by a closed session where the grad students met with the speaker for a freewheeling discussion without the more senior members of the department. Then, faculty and postdocs would begin arriving for the dinner party hosted by Lukas and his wife Marianne.

Lukas was passionate about safeguarding people who participated in research studies, and he helped spearhead the establishment of the first MIT Committee that reviewed all proposed experiments using human subjects, well before NIH mandated such committees. Further, in an address to the International Psychology Congress in Paris, he expressed a view that explains his support for the anti-war activities of MIT students: “Our particular science is as central as physics, and ultimately more so.



Teuber walking with Brenda Milner, both carrying papers related to a paper they were working on together.

But it is also capable of as much abuse. ... All of us here will have to abide by a new kind of Hippocratic oath, never to do harm, always to heal rather than hinder, to make life richer, and to make it free" (Teuber, 1978).

Richard Held

Richard Held (born 1922) was the department's second head, following the tragic loss of Han-Lukas Teuber in 1977. Dick grew up in New York City and attended a science high school and Columbia University, where he studied engineering and liberal arts, obtaining BA and BS degrees (1944). The engineering degree enabled him to apply for an officer's commission in the US Naval Reserve, which soon resulted in his becoming a tactical radar officer on an aircraft carrier. While on the ship, he studied a monograph by Wallach and Koehler on vision and visual aftereffects and illusions. When he returned to NYC, a colleague introduced him to Wolfgang Koehler. Dick soon joined Koehler at Swarthmore where he obtained the MS degree and began his work on visual adaptation to prisms. In the doctoral program in psychology at Harvard, he interacted with Georg von Békésy and completed a doctoral thesis on adaptation of auditory localization to systematic distortions in the relative timing of auditory signals to the two ears (1952). While at Harvard, Dick married Doris Bernays. They welcomed two sons and a daughter, and their marriage has endured for 64 years.

Dick joined the faculty at Brandeis University where he and his students investigated visual and visuomotor adaptations to various kinds of prism rearrangement. He realized that if the process of adaptation can result in a return of normal function, then such a process could be important in the early development of vision and visuomotor functions. To test this idea, he and grad student Alan Hein designed and conducted their famous "kitten carousel" experiments, which found the crucial importance of self-produced movement in development of visually guided reaching, as in human prism adaptation. Another student, Burton White, extended these findings



Doris and Dick Held at home in Cambridge.

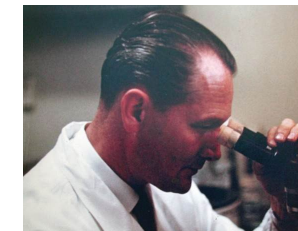
to human development and found that increased visuomotor interactions with environmental objects sped up the development of sensorimotor coordination in human infants living in the impoverished environments of state-supported orphanages.

In 1962, after serving as chair of the Brandeis department for a year, Dick took a sabbatical at MIT. Teuber had expressed an interest in having Dick join him as a senior faculty member in the new psychology section. He found MIT to be a stimulating environment and soon joined Teuber's faculty. Alan Hein also obtained an MIT faculty position and established a laboratory for further studies of visual development in kittens.



Held and BCS faculty member Alan Hein.

Later, with the able help of Joseph Bauer who came from Harlow's lab at Wisconsin, Dick altered the major work of his lab to studies of visuomotor development in monkeys, at the same time continuing the experiments on human adaptation to visual rearrangements. In the course of this work, Dick noticed interesting dissociations that he came to realize indicated two different modes of visual processing. This realization crystallized in interactions with others in the department in the autumn of 1966, especially in an evening seminar where the similarity of ideas of four different investigators in the department at that time became evident: These four organized



Walle at his microscope in building E10, MIT.

Photograph courtesy of Haring Nauta

Walle J. H. Nauta

Walle J.H. Nauta (1916-1994), with P.A. Gygax, developed a silver staining method that helped bring experimental neuroanatomy into the modern age. Born in 1916 in Indonesia, Walle earned his MD and PhD degrees at the University of Utrecht. During World War II, he practiced medicine, and he and his wife Ellie risked their lives by sheltering a young Jewish woman in their home. The Nautas have two daughters and a son. His PhD thesis, published in 1946, was a pioneering experimental study of brain-behavior relations. He studied the complementary roles of the anterior and posterior hypothalamic areas on sleep and waking, findings that have been supported by numerous subsequent research. Although he devoted most of his research career to neuroanatomical issues, Walle never lost a strong interest in the functions of the brain structures he described in his experimental work.

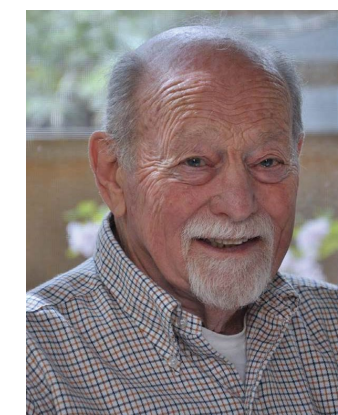


Walle Nauta (left) at a departmental retreat.

Photograph courtesy of Ernst Poeppel

a symposium for the 1967 meeting of the Eastern Psychological Association, with presentations by each of them: David Ingle (work on goldfish vision), Gerald Schneider (work on brain lesion effects in hamsters), Colwyn Trevarthen (studies of monkeys with sections of brain commissures), and Richard Held (studies of human adaptation to rearrangements of vision). Each of these investigators presented evidence in support of a separation of "what" and "where" functions in the visual brain. The notion spread rapidly throughout the psychology and brain science communities. The dissociation became encapsulated in the phrase, "two visual systems." In pursuing this idea, Poeppel, Frost, and Held studied patients with scotoma due to visual cortex lesions and found that humans with cortical blindness show a sparing of some ability to localize visual stimuli, despite their inability to identify the stimuli—the first demonstration of what later became known as "blindsight" (Lawrence Weiskrantz and colleagues).

Dick subsequently shifted the work in his lab to studies of visual development in humans: The baby lab replaced the monkey lab. Pioneering studies led by Jane Gwiazda with participation by several collaborators (Anne Moskowitz, Sarah Brill, and Indra Mohindra), obtained measures of refraction and acuity in infants. They discovered a high incidence of astigmatism in young infants and went on to examine stereoacuity, optokinetic nystagmus, and other abnormalities. The large body of refraction data on the infants led to the first-ever set of measurements on the pathophysiology of myopia, inspiring new investigations on the conditions that contribute to this disorder. After nine years as Head of the MIT Psychology Department, Dick stepped down. A few years later, at age 73, he and two main collaborators (Jane Gwiazda and Joe Bauer) accepted faculty positions at the New England College of Optometry. He continued to work part-time at MIT and currently collaborates with Pawan Sinha on Project Prakash, which examines vision in persons in India after removal of congenital cataracts. Thus in his 93rd year, Dick continues to ask major research questions about the nature of vision and to influence younger investigators with his wit and wisdom.



Held today, at 93 years young.

Nauta taught at the University of Leiden (1946-1947) while continuing his basic research, and then immigrated to the United States where he did research at the Walter Reed Army Institute of Research (1951-1964) and taught at the University of Maryland (1955-1964). He came to MIT in 1964, already well recognized as a leading systems neuroanatomist, and his appointment in a department of experimental psychology was unique at that time. At MIT, Walle conducted research with graduate students, postdoctoral fellows, and research associates in the Department of Brain and Cognitive Sciences until his retirement in 1986. Nauta used his silver-staining method and its modifications to study various systems throughout the CNS, especially the various pathways closely associated with the hypothalamus—the limbic system pathways. He extended the concept of the limbic system to include structures in the midbrain core. His studies with research associates and graduate students also led to the definition of a limbic-system portion of the corpus striatum. He was named an Institute Professor in 1973.

Nauta was an avid sailor. He races his sailboat, a 17-foot Thistle, in Boston Harbor on many weekends in the spring, summer and fall. His son Haring often crewed with him. ■

In Their Own Words

BCS graduate students then and now

By Rachel Traughber, BCS

In 1965, the Department of Brain and Cognitive Sciences graduated its first four Ph.D. students. Whitman Richards, Donald Pfaff, Gerald Wasserman, and Joseph Mendelson went on to have successful careers in academia, and were interviewed in 2005 about their experiences both at the department and since their graduation. In 2015, as the department celebrates 50 years, we interviewed four current graduate students about their science, their experiences, and their career goals. The faces may have changed, but the dedication to cutting edge research and scientific discovery that is a hallmark of the department's legacy remains the same.

OUR FIRST PhDs: 1965

Reprint from BCS News 2005

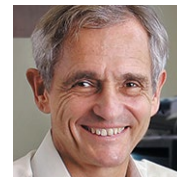
In 1965, the MIT Department of Psychology awarded doctoral degrees to its first four graduates. BCS News recently asked the members of this first class to reflect on their time with the Department as well as where their careers led them after MIT.



WHITMAN RICHARDS, PhD 1965

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. Informal discussions with Vannevar Bush convinced me to change careers and to restart from scratch, so I could join this new wave. After meeting Teuber, I knew MIT was a near-perfect fit. Teuber's charisma and broad vision for a new psychology was a powerful draw, as well as his own research interests as reflected in the Perception chapter he wrote for Field's Handbook of Physiology. With MIT's prestige and resources, plus the flexibility of the new program, there was a unique opportunity for a non-traditional grounding in a discipline otherwise mired in tradition. Individuals of special interest to me at the outset were Teuber and his young "family" of colleagues – especially Wayne Wickelgren and Dave Green, as well as the many neighboring luminaries in RLE and EECS. I never looked back!



DONALD PFAFF, PhD 1965

I took a risk, giving up acceptances at Harvard and elsewhere, to come to MIT because (1) I was impressed with Professor Teuber's plans for uniting the study of CNS mechanisms with behavior; (2) his new department was

flexible enough that I could cross-register at Harvard Med for CNS and endocrine physiology courses; and (3) the professors would let me help shape my own academic program.

The department was brilliant, with Teuber, Altman, Ron Melzack, John Swets, etc., though we rattled around Building 20 for a year before moving to a new building. I joined Joe Altman's lab, impressed by his histochemical techniques that combined high spatial resolution with great chemical specificity.

Coming to MIT was my best professional decision because I was allowed to supplement the Department's training with the Harvard Med courses plus courses in the Electrical Engineering department (Michael Dertouzos, finite state automata theory, referred to in my latest book, from Harvard), and the Biology department (e.g., Pat Wall and Jerry Lettvin). Joe Altman's standards of scientific craftsmanship and novelty are with me still.

I feel lucky when it comes to my career path. I went to Rockefeller expecting to stay for a two-year NSF postdoc. However, because my results at MIT (discovering hormone receptors in the brain) brought some attention, I was promoted rapidly at the Rockefeller. I was also elected to the American Academy of Arts and Sciences (1992), and to the National Academy of Sciences (1994). From my current outside view: BCS still looks terrific. For work related to my interests, Earl Miller is famous and Nancy Kanwisher is carrying a high profile. I admire the BCS program and would choose it again in a trice. These days the Pfaff lab at Rockefeller is using new molecular techniques to analyze: 1) how the mammalian brain manages specific natural behaviors such as sex, fear, and aggression; and 2) hormonal and genetic influences on generalized brain arousal. While some of this work can be done in nerve cell lines, it is also necessary to study nerve cells in their normal synaptic context to see how, in the governance of behavior, the brain's special connectivity interacts with the types of molecular mechanisms seen in other tissues.



GERALD WASSERMAN, PhD 1965

The new department at MIT was attractive because Luke Teuber was going to be its first Head and he had the force of gravity. It turned out to be a very exciting place to be because everything was being

done de novo and Luke was brimful of ideas about the right way to build a community of scholars, a phrase he used as he pursued his ultimate goals. I particularly treasure the memories of the regular Friday evening post-colloquium gatherings that he and Marianne hosted in their Arlington home. Everything was open for discussion and everything was vigorously discussed. In due course, Luke would often start a schauspiel which nominally presented intriguing aspects of the behavior of the brain-injured patients he had examined but actually gave him an opportunity to display his remarkable ability as a performer. The latter included an adequate supply of impish grins and grand eyebrow levitations. This was heady stuff for a provincial kid from Flatbush. Above all, Luke treasured wit and the free play of the intellect. And his spirit infected the whole department. Of course, younger people may look at a serious photo of my research setup then and, focusing on the facial expression and the tie being worn, find it hard to believe that there was any free play in those days. But Luke had the gift of seeing through surface appearances. The department he founded has inherited that penetrating characteristic, which has contributed to its eminence. Those of us who were privileged to train at MIT particularly benefited from Luke's way of treating students as friends and colleagues and I have passed this tradition on to my own students.

I left MIT for a postdoctoral position at the NIH with Mike Fuortes. Subsequently, I joined the faculty at the University of Wisconsin-Madison, and later was attracted to Purdue University where I am currently a Professor of Psychobiology. Most of my research has addressed Jerry Lettvin's question (what the eye really says to the brain) by examining the temporal properties of visual signals in the eye of the horseshoe crab. Recently, I took up the complementary question by examining the role of the neuromodulators released into this eye by efferents from the crab's brain. My group found that they can either accelerate (Substance P) or retard (Octopamine) the timing of photoreceptor potentials. The implications of these characteristics for selective attention and change blindness make their prevalence in other visual systems a current concern.



JOSEPH MENDELSON, PhD 1965

During my senior year at McGill University my mentor, Prof. Dalbir Bindra, suggested that I pursue graduate studies at MIT. He had heard from his friend, Prof. Davis Howes, who was on the faculty of MIT, that

a psychology department was in formation. When I visited MIT during one of Prof. Teuber's visits from NYU, it became clear to me that this was an unusual and unique opportunity. Prof. Teuber decided to accept four students into a non-existent graduate program in psychology. The four, Don, Jerry, Whitman, and myself, were to be at the mercy of 17 faculty, but we were actually treated more like colleagues than like students, and given offices and permitted to cultivate our independent research interests. Rather than being forced to choose to work on a faculty member's research project, Jerry and I were allowed to go off in pursuit of our own personal research interests, which did not match those of any of the faculty. We were generously supported by the faculty and given maximum freedom in our research. In addition, my approach to psychological problems, developed under Professors Hebb and Bindra at McGill, was a perfect match for that of Prof. Teuber, who also served as a magnet, attracting all the great minds in biopsychology to visit and give seminars and colloquia.

In 1965, I left MIT for the University of Michigan to study as a postdoc with Steve Glickman and Jim Olds (arranged by Prof. Helen Mahut at MIT). This was followed by four years at Rutgers University and 26 years at the University of Kansas, Lawrence. I retired from the university in 1997 and, since then, have been living in Jerusalem, surrounded by my seven children and dozen (at last count) grandchildren. Because of the lack of the types of schools I wanted for my children in Kansas, I had already moved my family to Jerusalem in 1978 and commuted for the next 20 years. In the summer of 1969, I even started the first research program in biopsychology at the Weizman Institute of Science, which is still going today. In 1970, I turned down an offer from an Israeli University.

My retirement from Kansas brought a career change and my current title is Kosher Food Inspector. As such I conduct kosher inspections of kosher-certified food-production factories, most of which are in Morocco, Tunisia, and Bulgaria, but I have also done inspections in half-a-dozen other countries, including a two-month stint in China where I inspected about 30 of the 600 facilities which are kosher certified. Most of the time, however, I am in Jerusalem, living in an apartment which overlooks the whole of the central city and, on a clear day, I can see from my window the mountains of Moab rising on the far side of the Dead Sea.

50 Years later: graduate students in 2015



BEN DEEN, 6th year graduate student

Undergraduate: Yale University

I am a neuroscientist motivated by cognitive science questions. While my main interest is in how the brain works, and how it achieves various

computations, I anchor my research in the questions from cognitive science, focusing on two broad thrusts: 1) How do we make abstract inferences about people's thoughts and intentions based on their face and body language, vocalizations, and other social cues? The translation of concrete perceptual inputs such as these into high-level social properties is a fascinating but difficult problem. 2) There are regions in the adult brain dedicated to specific cognitive and perceptual processes, including visual regions that process specific categories of input, such as faces. How do these regions (and the corresponding processes) develop? Are we hardwired to have these regions, or do we have them because (e.g.) we see faces all the time?

I've tried to discover the answer to this second set of questions through the study of infant development using functional MRI. fMRI is very sensitive to head motion, which has been a big challenge with babies. In order to get sufficient high-quality data, I've run many, many scans of babies over the last few years. I then worked to develop sophisticated data analysis techniques to extract a meaningful signal from this noisy data. We found that to a good extent infants do have the category-sensitive visual regions that adults have, including regions preferring faces to other types of input. It was very exciting because it was not at all clear that this would be the case – many scientists still consider the cortex of infants to be largely a blank slate. We were able to ask a broad and deep question and get a satisfying answer.

My research interests lie at the intersection of the Saxe and Kanwisher laboratories. While I applied to a few places outside of MIT for graduate school, I was very excited about their work. I heard wonderful things about both Nancy Kanwisher and Rebecca Saxe before I arrived at MIT, which have been borne out by my personal experiences in their labs. In addition to their scientific excellence, they are great people, excellent advisors, and are researching fascinating questions.

My advice to new graduate students, or potential grad students, would be to think very carefully about your research question. It's probably the most important thing

you will address in grad school, and relates to everything else, from how you will spend your days to whom you choose as your advisor. Get a broad sense of what is available and find what motivates you the most. Graduate school is an incredible amount of work, and you need to pick something that will motivate you to work hard and provide opportunity for discovery, both personal and scientific.



Magid and Remy Scott completing an experiment in the Early Childhood Cognition Laboratory.

Photograph courtesy of Sarah Saab

RACHEL MAGID, 2nd year graduate student

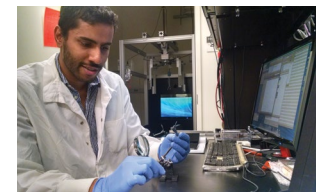
Undergraduate: Wellesley College

As children, we toddle around, taking in the linguistic evidence from adults around us, making mappings between words and what they describe, and inferring hidden structure in the sentences spoken

around us. Young children are able to do this without explicit instruction, a far cry from the experience of older adults learning another language. But learning language is far from our only achievement in childhood. Over the course of our development, which is prolonged compared to those of other mammals, we accomplish many extraordinary yet seemingly commonplace achievements. We transition from beings in need of round-the-clock care to competent adults— each with our own set of skills and values. As adults we often pursue endeavors that make use of our particular interests, skills and values. My main research interests lie in understanding what we know about ourselves, as well as how we learn what we know, to allow for this learning and specialization to unfold. I study these questions with Professor Laura Schulz in the Early Childhood Cognition Lab.

I chose to study and train at MIT because I feel a deep intellectual connection to this department. I have a particularly salient memory from graduate interview day, where various faculty members gave "lightning" talks, presenting highlights of recent cutting edge work from their labs. As I was listening to these talks by scientists who are making discoveries almost daily, often in collaboration with their graduate students, I felt like I was so close to the edge of knowledge, which was incredibly exciting and moving. This department is one of the first places where researchers started studying the mind and brain in tandem, and researchers here have and continue to make groundbreaking contributions to our scientific knowledge. Further, faculty members are committed to

the training of students in this department and to our development as scientists, mentors, and members of a global-community engaged in the pursuit of a better understanding of what's going on in each and every of our heads.



RISHI RAJALINGHAM, 4th year graduate student

Undergraduate: McGill University
Masters: McGill University

Rajalingham manipulates a linear array injectrode. The probe has multiple electrode contacts along its shaft for recording the activity of multiple neurons simultaneously, as well as a fluid capillary in the shaft for injecting pharmacological agents to perturb neuronal activity.

Neuroscience really wasn't on my radar as a child. My dad is a mechanical engineer who encouraged me in my love of math - I thought I was going to be an astrophysicist. And while I love music and

writing and considered both of those options, for practical reasons, I became an engineer. I knew I wanted to go to graduate school and was debating what direction to choose I when I took a graduate level neuroprosthetics class. The professor in that class introduced me to neuroscience and became a mentor that I still value today.

Neuroprosthetics proved to be an incredibly engaging field. It's the meeting place between science and engineering, and is one of the ways we can process our understanding of the brain and use it for real applications. A great example is the cochlear implant, which, after implantation, becomes an interface for those who can't hear, allowing them to process sound for the first time. We might also be able to take our understanding of motor control and even higher level things, like the desire or intent to move and use that information to move artificial limbs.

The idea of basic science translating to applications like these is very important to me. I enjoy research and science for the sake of itself, but keeping potential applications in mind as I go about my day drives me in the lab.

My current research in Jim DiCarlo's laboratory asks whether we can stimulate the brain and change someone's visual perception, and if so, where, and what are the codes, the spatial patterns, and the temporal patterns? Working with a postdoc in the lab, we had an experiment recently that showed if you inhibit certain parts of the brain, the test subject was completely unable to

distinguish genders. Scientifically it was just a fantastic moment, showing a causal effect between the brain tissue we inhibited and behavior. It was by far one of the best days I have ever had in the lab and reaffirmed my love for science and the scientific process. What if, through basic research experiments like these, it was possible to build a foundation that could eventually enable the creation of a device like the cochlear implant for people who are blind?

The cutting edge level of research we are exposed to at MIT is astounding. It's very exciting to be involved with such rigorous, frontier science. People are developing new tools right here in the building that I am able to use almost immediately in my experiments. Every day, you know that something is happening here that is not happening anywhere else. It's incredibly invigorating, and something that I hope I contribute to in my own way.



Ramirez leads a tour of the Tonegawa laboratory during Brains on Brains 2015.

STEVE RAMIREZ, PhD 2015

Undergraduate: Boston University

When I was going into college I had no idea what I wanted to do. I loved everything from biochemistry

and music to Shakespeare and philosophy, and I wasn't sure if it was possible to combine these things. My sophomore year I was working in a lab and a piece of equipment broke, so I had to go to another lab to use their equipment. I show up there, and using the piece of equipment was the girl I had a crush on all sophomore year. I asked her how to use the equipment, we made small talk about our interests, and she pointed me in the direction of a professor who, within a year's time, became the director of Boston University's undergraduate neuroscience program. During that initial meeting with him, it clicked that by studying the most multidisciplinary organ you inadvertently get access to everything that's ever been achieved – the Hamlets, the antidepressants, the moon landings. Neuroscience seemed like a natural fit for my broad interests.

At the end of college, I started thinking about applying for grad schools. For me, acceptance at MIT was the ultimate dream, but maybe a stretch. I was nervous about applying, because I was a B student in high school, and a B and A student in college. And then I did, and when I met everyone through interviews there was a palpable synergy. I knew it was the place I could do all of the research in

learning in memory that I wanted to because half the building was dedicated to it.

The research question interesting me at the moment is whether or not there is there a way to turn artificially activated memories into anti-depressants and anxiolytics. Right now, depression and anxiety are usually treated with drugs that flood the brain with chemicals like serotonin. As helpful as these drugs can be, serotonin, for instance, has many other effects on the brain outside of helping with these disorders and may not be the best way to treat them long term. Instead, why not go in and hijack the internal machinery of the brain that we know can produce feelings of warmth, and positivity, and turn it on? The futurist in me wants to be able to activate positive emotions when people are going through an anxiety attack or positive memories during a depressive state—a prospect that bridges the fields of memory and psychiatric disorders to come up with an effective, less invasive treatment, and simultaneously to understand more clearly what exactly memory is and how it works.

Research is the great equalizer. It doesn't matter how brilliant you are; you have to work hard. You have to work hard to figure stuff out. You have to learn to roll with the punches. My dad came from El Salvador in the late 70s to get away from the civil war and to give me, my brother, sister and mom a fighting chance to have an education and impart goodness in the world. Not surprisingly, my dad's Mr. Optimism. He's unbreakable in every way and that attitude rubbed off on me. When problem solving, he likes to say, "It's not a matter of if, it's a matter of when and how." That's definitely something that is both of my parent's mottos – get your hands dirty, solve one thing at a time, and over time that amounts to a successful career and a happy life—those two things never have to be non-overlapping.

Ramirez graduated from MIT in October 2015, and is now a member of the Society of Fellows at Harvard. ■■

MIT's Brains on Brains

A day exploring the minds and research of building 46

By Rachel Traugher, BCS



On May 4, 2015, the Department of Brain and Cognitive Sciences hosted its biennial symposium, **A Day with MIT's Brains on Brains**.

"In creating the agenda for Brains on Brains, we wanted to expose our guests to a cross section of the research initiatives in MIT's brain and cognitive sciences community, while making sure they were able to interact with the people behind the research as much as possible," explains BCS Department Head Jim DiCarlo.

Attendees were treated to a morning of short talks by BCS Professors Jim DiCarlo, Emery Brown, Nancy Kanwisher, Guoping Feng, Kay Tye, and Michale Fee ranging from presentations on psychiatric research and anesthesia to the auditory cortex and birdsong. A lunch with the department faculty, students and researchers allowed for plenty of one on one interaction at themed tables to help stimulate conversation.

After lunch, guests participated in a set of customized graduate student and postdoc led tours spanning the breadth of brain and cognitive research. From animal models of behavior and disease to a variety of brain mapping technologies, guests were introduced to the full range of scientific research in building 46. Special guest MIT Provost Martin Schmidt brought the symposium to a close, thanking both guests and presenters and kicking off the reception.

Interested in learning more about Brains on Brains? Visit brains.mit.edu for more information, including videos of this year's symposium. ■■



BCS Whitehead Career Development Assistant Professor Kay Tye leads a lunch table on addiction at Brains on Brains 2015.



Guest Elizabeth Jensen participates in a laboratory tour during the afternoon.

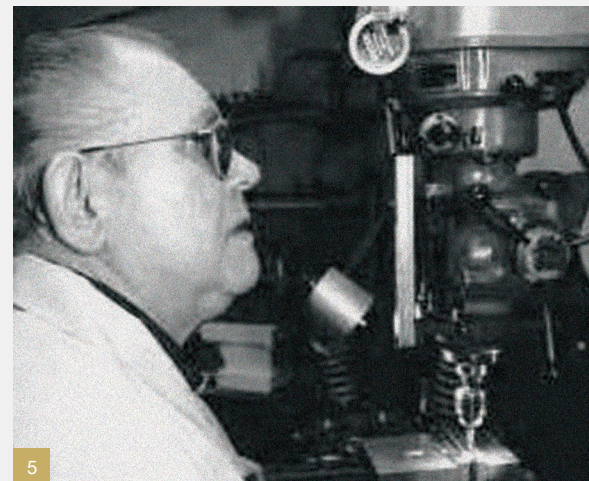


BCS Professor Emery Brown delivers his lecture "The Dynamics of the Unconscious Brain Under General Anesthesia" at Brains on Brains 2015.



Nancy Garvey and BCS alumna Kate O'Neal '15 chat with department head Jim DiCarlo at Brains on Brains 2015.

BCS Community News



1. **Peter Gibson**, BCS UROP, finished his summer rowing season by coming 5th at the world championships in the lightweight men's pair. This was the first time that the US had been in the final of that event since 2003.

2. The department welcomes new graduate students: Back row L – R: **Sean Houlihan, Luke Hewitt, Dustin Hayden, Sarah Schwettmann, Peilun Dai, Michael Lee, Chad Sauvola**. Front row L – R: **Anthony Martorell, Rosary Lim, Madeline Cusimano, Yi-Ning Leow, Xiangyu Zhang, Marie-Sophie van der Goes, Lou Beaulieu-Laroche**

3. BCS undergraduate **Francisco Pena** celebrates with his family during the department's graduation celebration.

4. Through a fellowship granted by the Experimental Study Group and the Priscilla King Gray Public Service Center, **Sofia Essayan-Perez** worked on strengthening math and science education in rural high schools in Nicaragua, helping to develop low-cost pedagogical resources while integrating technology in the classroom. Sara, RN (left), receiving some of the didactic materials for the clinic's collaborations to create lesson plans and educational videos for STEM concepts and local health issues from Sophia (right).

5. **Sylvester Szczepanowski** passed away December 14, 2015. Sylvester began his career at MIT in 1978 and was hired by the department in 1987, where he worked in the BCS machine shop until his retirement in 2004. The department's thoughts are with his friends and family during this difficult time.

Noteworthy News

Faculty

Joint Associate Professor **Ed Boyden** won the 2016 Breakthrough Prize (Life Sciences) along with Karl Deisseroth for their work on optogenetics. The Prize, founded by Sergey Brin and Anne Wojcicki, Mark Zuckerberg and Priscilla Chan, Yuri and Julia Milner, and Jack Ma and Cathy Zhang, honor important, primarily recent, achievements in the categories of Fundamental Physics, Life Sciences and Mathematics.

Professor **Emery Brown** has been selected a 2015 Guggenheim Fellow.

Four BCS faculty members received named chairs: **Gloria Choi** was named to the Samuel A. Goldblith Career Development Professorship; BCS Department Head **Jim DiCarlo** was named to the Peter de Florez Professorship; **Mehrdad Jazayeri** was named to the Robert A. Swanson Career Development Professorship in the Life Sciences; and **Josh McDermott** was named to the Fred and Carole Middleton Career Development Professorship.

Assistant Professor **Mehrdad Jazayeri** was selected for a Klingenstein-Simons Fellowship Award in the Neurosciences.

Professor **Nancy Kanwisher** received the 2015 Outstanding Postdoc Mentor award. The Brain and Cognitive Sciences Community's postdoc committee established this award to recognize excellence in mentoring and to raise awareness of the essential role that mentors play in the career development of postdocs.

Assistant Professor **Josh McDermott** received an NSF Career Award. The award recognizes junior faculty who exemplify the role of teacher-scholars through outstanding research, excellent education and the integration of education and research within the context of the mission of their organizations.

Professor **Rebecca Saxe** received the Arthur Smith Award for Distinguished Service to Student Life and Learning at this year's convocation.

Assistant Professor **Kay Tye** received the Harold E. Edgerton Faculty Achievement Award. The award recognizes exceptional distinction in teaching and research or scholarship. She also was selected as a 2015 Outstanding UROP Faculty Mentor.

Assistant Professor **Feng Zhang** was selected as a 2015 Blavatnik Award for Young Scientists in the Life Sciences national finalist. The award supports and honors outstanding scientists and engineers by encouraging and accelerating innovation through unrestricted funding and by recognizing their extraordinary achievements as vital contributions to science and society.

Students

Ph.D. students **Emily Mackevicius, Joshua Manning, Hilary Richardson, Kimberly Scott, Laura Stoppel, Pedro Tsividis, Caitlin Vander Weele, and Yang Wu** received the Angus MacDonald Award for Excellence in Undergraduate Teaching (2015).

Rebecca Canter, Emily Mackevicius, and Laura Stoppel have been selected as MIT Graduate Women of Excellence.

Idan Blank received the Walle Nauta Award for Continuing Dedication to Teaching.

BCS alumna **Amy Brand** has been named director of the MIT Press.

Elizabeth De Laittre received the Walle J.H. Nauta Award for Outstanding Research in Brain and Cognitive Sciences.

Alexandriya M. Emonds received the BCS Hans Lukas Teuber Award for Outstanding Academics; was a Tau Beta Pi Inductee; and is eligible for Eta Kappa Nu.

Sofia Essayan-Perez received the BCS Hans Lukas Teuber Award for Outstanding Academics; the Walle J.H. Nauta Award for Outstanding Research in Brain and Cognitive Sciences; was a Phi Beta Kappa Inductee; and received the Priscilla King Gray Award during the MIT Awards Convocation.

Ann D. Felhofer received the Walle J.H. Nauta Award for Outstanding Research in Brain and Cognitive Sciences.

Dario Garcia-Dominguez received Emerson Fellowship award and MIT Symphony Orchestra competition winner.

Lea Hachigian received the Walle Nauta Award for Excellence in Graduate Teaching.

Brianna J. Jones is a Palitz Fellow.

Brenden Lake received the Glushko Dissertation Award, an annual award that is given to the 4-5 best PhD theses in all of cognitive science.

Francisco X. Pena received the Walle J.H. Nauta Award for Outstanding Research in Brain and Cognitive Sciences.

Micah Nishigaki received the Ronald E. McNair Scholarship Award during the MIT Awards Convocation.

Steve Ramirez has been labeled an Emerging Explorer by National Geographic. The program, which defines explorers broadly to include scientific and intellectual exploration, seeks to identify and support "young trailblazers whose ideas are helping change the world."

Rebecca D. Shi received the BCS Hans Lukas Teuber Award for Outstanding Academics, and the Walle J.H. Nauta Award for Outstanding Research in Brain and Cognitive Sciences.

Christina Spicer received the Walle J.H. Nauta Award for Outstanding Research in Brain and Cognitive Sciences.

Erika S. Trent received the BCS Hans Lukas Teuber Award for Outstanding Academics.

Congratulations to the following students who graduated in spring 2015:

Ph.D. Andrew Donald Bolton, Gregory John Hale, Melissa Elizabeth Kline, Jorie Koster-Hale, Brenden M. Lake, Joshua Brandon Manning, Joshua Handman Siegle, Ethan Mikael Skowronski-Lutz, Andreas Stuhlmuller, Todd Wesley Thompson, Tomer David Ullman. **S.M.** Diego Ardila, Christine Eckhardt, Michael Benjamin Lynn **S.B.** Michelle S. Anand, Benjamin R. Bauchwitz, Michael K. Behr, Austin C. Boesch, JooHee Choi, Rachel L. Cuozzo, Elizabeth A. De Laittre, Alexandriya M. Emonds, Sofia Essayan-Perez, Ann D. Felhofer, Dario Garcia-Dominguez, Gordon Gopher, Ian M. Gorodisher, Dmetri M. Hayes, Chrysonthia A. Horne, Stephanie A. Ihezue, Ehsan Izadmehr, Brianna J. Jones, Shivani A. Kaushal, Kira S. Kopacz, Emily K. LaVerriere, Emily K. Lydie, Jessica Maghikian, Micah A. Nishigaki, Katharine A. O'Neal, Hyoung Jun Park, Francisco X. Pena, Kristina L. Presing, Jacovie D. Rodriguez, Rebecca D. Shi, Christina Spicer, Erika S. Trent

A selection of books
produced by faculty and
alumni of the department
over the last 50 years.

