



NEW IMAGING CENTER BRINGS POWERFUL TOOLS TO BCS RESEARCH

The history of the new Martinos Imaging Center mirrors the history of imaging at MIT. The longstanding interest in brain imaging at BCS began with the early work of Suzanne Corkin, whose research on neural mechanisms of memory led her to analyze skull films and pneumoencephalograms of patients with brain damage, World War II veterans, Alzheimer's patients, and, most significantly, patient HM. The methodological advances in Corkin's work since those early days closely reflect the progress of new scanning techniques, encompassing first Computerized Tomography (CT) and Positron Emission Tomography (PET) scans, then functional Magnetic Resonance Imaging (fMRI).

As MIT initially had no facilities for this type of work, Corkin was forced to look elsewhere, eventually conducting most of her brain scans at the Charlestown campus of the Massachusetts General Hospital (MGH). With the recruitment of Nancy Kanwisher and others in the late 1990s, BCS reached the needed critical mass in brain imaging research and things began to snowball. Members of the Corkin and Kanwisher labs began spending many hours in Charlestown, and in the year 2000, an agreement

was established between MGH and MIT allowing freer access to the machines for departmental investigators.

As more faculty members with imaging components to their research programs were recruited to BCS, demand for time on the MGH machines began to strain their availability and the need for an imaging facility at MIT became increasingly clear. In spite of the obvious need, it took some years and the convergence of multiple events for the vision of a local imaging facility to be realized. The primary catalyst for change came in the late 1990s when Thanassis and Marina Martinos committed to then-MIT President Chuck Vest that they would sponsor the founding of an imaging science center. This center, named for their daughter, would focus on applications of imaging to understand mental illness and neuroscience.

Initial funding from the Martinos family was given in support of the MGH/Charlestown facility, which was re-named the Athinoula A. Martinos Biomedical Imaging Center at MGH; and for a number of years, BCS researchers continued the commute across town. Meanwhile, a team that included Martha Gray and Daniel Shannon of HST, Corkin, Kanwisher, Emilio Bizzi and Mriganka Sur of BCS, Bruce Rosen of MGH and HST, and

Continued inside . . .

NEWS FROM THE BENCH

Unraveling the Mysteries of Alzheimer's

Why do some people live to be 100 without falling victim to Alzheimer's disease? Li-Huei Tsai wants to know. Beta-amyloid (a protein fragment that accumulates in the brains of Alzheimer's patients) is a telltale sign of the disease, which affects 4 million Americans, most over age 65. Normally, the body manages to break down and eliminate these fragments, but in the aging brain, they tend to form insoluble plaques. To add to the mystery, some people function relatively normally with plaques nestled among their neurons, while others are virtually incapacitated. "There are people with a significant plaque load who can keep up with their daily lives," said Tsai, who has appointments in the Department of Brain and Cognitive Sciences and the Picower Institute for Learning and Memory. "Obviously, other factors are determining whether they have full-blown Alzheimer's." Tsai, who as a child in Taipei witnessed her grandmother's descent into dementia, is determined to unravel the thorny questions associated with neurodegenerative and psychiatric disorders.

Yes Virginia, There is LTP in Learning

Researchers in Mark Bear's lab report in the August, 2006 issue of *Science* that certain key connections among neurons get stronger when we learn. "We show what everyone has always believed, that long-term potentiation is indeed induced in the hippocampus when learning occurs," says Bear. "This is a big deal for neuroscientists because such evidence has been absent for the 30-plus years we have known about LTP."

A New Approach to Imaging Brain Activity

If you want to see precisely what the 10 billion neurons in a person's brain are doing, a good way to start is to track calcium as it flows into neurons when they fire. To that end, Alan Jasanoff has developed a new nano-sized calcium-sensing contrast agent that is detectable by magnetic resonance imaging (MRI) scanners. The new agent, which incorporates extra-strength molecular-sized magnets, results in large MRI

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If you would like to be put on the newsletter mailing list, or have information you would like to have published, please contact:
Judith Rauchwarger
Human Resources Administrator
jrauch@mit.edu

BCS Alumni Please
Keep In Touch
Denise Heintze
Academic Administrator
heintze@mit.edu



A technician from Siemens explains the workings of the new 3T human magnet to Magdalena Sauvage and Technical Instructor Patricia Harlan.



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MIT's Dean Robert Silbey and Provost Robert Brown worked to define a vision for an on-campus facility. Convinced that MIT was poised to make enormous progress in this field, the Martinos family provided a substantial initial gift and the cornerstone of the facility in Building 46 was thus laid.

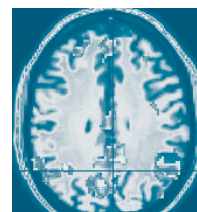
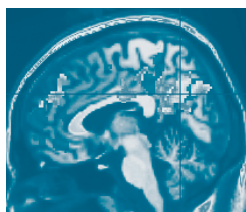
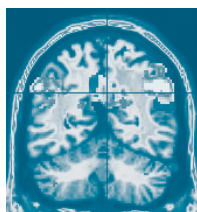
After 2000, one phase after another began to fall into place, and progress shifted into high gear. The facility was included in the Building 46 programming providing a committed space for housing the MRI magnets. A year later, with the groundbreaking for the new building, the Center had a clearly delineated space within the McGovern Institute. Leadership for the new Center came in the form of Professor John Gabrieli who was recruited to MIT from Stanford in 2005. Gabrieli wears many hats, holding joint appointments in BCS and HST as well as serving as co-Director of the Clinical Research Center, Associate Director of the Martinos Center at MGH, and Director of the Martinos Imaging Center at MIT. The first magnet for human imaging at MIT was installed in 2005, going on line early in the summer of 2006 when Nancy Kanwisher produced the first brain scan on the machine.

The Center, housed on the ground floor Building 46, has three bays. One bay houses the first 3 Tesla human magnet, while another has a 9.4 T magnet (bought recently with a gift from an anonymous donor). The third bay is currently empty, awaiting the development of new technology. The variety of machines reflects the diversity of research conducted in the Center. In general, the higher T translates into greater image resolution but results in smaller fields that can be scanned. The 3T magnet has a 60 cm bore, and is a whole body imager, though it is expected to be used only for imaging human brains. The opening for the 9.4 T magnet is only 12 cm, not suitable for human work, but it does have sub-millimeter resolution.

Already the facility is humming with activity. All protocols are in place and subjects are being run. The Center is breaking barriers, serving to potenti-

ate new collaborations among faculty in many areas. In July of this year, Rebecca Saxe, the newest addition to the BCS faculty, along with Gabrieli and colleagues, submitted the first paper for which brain scanning was entirely done on the MIT campus.

And there is much more to come. Assistant Professor Chris Moore, along with lab members Junjie Liu and Mitul Desai, is already designing the next



Functional MRI images of the human brain can identify centers of activity based on increased blood flow. Images courtesy of Rebecca Saxe

generation of magnetic microcoils, aimed at delivering resolution down to less than a tenth of a millimeter. "It is a really great tool to have in your tool-kit," says Chris Moore, "this gives us a totally safe and non-invasive technique for imaging single layers in cortex, or even single cortical columns." Moore and his lab hope to combine physiological recordings, optical imaging and brain scanning to maximize resolution as well as coverage, as they probe structure-

News From the Bench Continued from Page 1

contrast changes capable of producing very high-resolution images. The work is reported in the September, 2006 online edition of the *Proceedings of the National Academy of Sciences*.

Nanotechnology Breakthroughs in Medicine

Jerry Schneider and Rutledge Ellis-Behnke have recently reported several findings that illustrate the remarkable potential for the use of nanotechnology in research and medicine. In the October 10, 2006 online edition of *Nanomedicine* the BCS team along with Hong Kong University researchers have shown that some simple biodegradable liquids can stop bleeding in wounded rodents within seconds, a development that could significantly impact medicine. "We have found a way to stop bleeding, in less than 15 seconds, that could revolutionize bleeding control," says Rutledge. Earlier this year, the same researchers reported that a similar liquid was able to partially restore sight in hamsters that had had their visual tract severed.

function relationships in the brain.

Martha Gray reiterates that both footprints of the Martinos Center, the one at MGH and the one at MIT, are unique. "We have here the opportunity to bring together the best biology, the best medicine and the best engineering in the world. Biomedical imaging is an enormously important enabling technology, for biology as well as for medicine. By bringing the horsepower of a place like MIT to bear on issues of brain imaging, we can really impact biomedical research in ways that are not going to happen in industry. The problems that we can address, and the people who can address them, are completely unparalleled at any other place."

When asked if the Center was the major factor in his decision to come to MIT, Gabrieli pauses a moment, then says with a laugh that he would have come anyway. "MIT's explosion of neuroscience opportunities is hugely attractive. It is a historically good moment to be here, because of the focus on neuroscience." He adds "But having the Center makes it fun to wake up here in the morning!"

In this instance, the self-assembling peptides served as an internal matrix on which brain cells could re-grow. Related papers by the group appear in the August, 2006 issue of *Chemistry Today*, and October, 2006 issue of *Current Pharmaceutical Design*.

Learning is in the Eye of the Beholder

The artist's trained eye can detect distinctions others can't; musicians pick up subtle changes in tone lost on the nonmusical. Brain researchers call these abilities perceptual learning. Mark Bear and colleagues have uncovered a mechanism for this phenomenon. "Understanding this type of perceptual learning is important because it can reveal mechanisms of implicit memory formation and might be exploited to promote rehabilitation after brain damage. Detailed knowledge of how practice changes brain chemistry is likely to suggest new pharmacological and behavioral therapies to facilitate these changes," said Professor Bear. The study appeared in the August, 2006 issue of *Neuron*.

INCOMING BCS GRADUATE STUDENTS A DIVERSE GROUP

Ben Auerbach was born and raised a rabid Bills fan in Buffalo, NY. He attended Cornell University as a biology major with a concentration in neurobiology and behavior, and his research interests are in linking cellular mechanisms with behavior. He is especially interested in neuronal plasticity and the dynamic balance between specialization and integration the brain must achieve, and plans to continue doing academic research as a career. Outside of science, he enjoys playing sports, especially soccer and basketball and is also into music. He plays piano (mostly blues and jazz) and is starting to tinker with production.

Lauren Barr came to Boston in July, 2004, after 18 years in Pendleton, IN, and 4 years at the University of Pennsylvania where she earned degrees in biochemistry and biotechnology. She has spent the last 2 years as a medical student in the HST program where she thoroughly enjoyed perfecting the art of cadaver dissection and practicing IVs on her classmates' arms. She has joined the Littleton Lab where she studies the molecular mechanisms of synaptic plasticity in *Drosophila*. She plans to complete medical school and specialize in anesthesiology combining research with clinical practice. Outside of the lab, Lauren is a fantasy football champion and collector (in quantity) of shoes.

Tim Brady was born on Long Island and went to college at Yale University, where he majored in Cognitive Science and conducted research in a vision and cognitive neuroscience lab. He is interested in studying scene understanding, visual search, and learning from visual context. He enjoys running and reading just about everything, as well as his frequent trips to New York where most of his high school and college friends are now living. He was recently engaged to a psychology grad student at Harvard.

Greg Hale hails from New Brunswick, New Jersey, where he studied psychology and neuroscience at Rutgers. He is interested in learning *in vivo* physiology techniques to study systems-level questions in learning and memory, and hopes to some day run his own electrophysiology lab and to write science for general public consumption. Outside the lab he juggles (a lot), and claims that juggling leads to some interesting changes in cortex.

Mark Howe is proud of his Wisconsin origins. He answers the inevitable two questions about his provenance with: yes, he likes cheese, and no, he is not a Packers fan. Mark graduated from UW-Madison with a degree in neuroscience and plans to narrow his focus to the study of neural circuitry at the systems level. In his free time, he enjoys outdoor activities such as hiking, biking, bird watching, golfing, and wandering with no particular destination in mind. Eons from now he hopes to be enjoying a lifelong career in academia as a professor.

Although initially trained as a computer scientist **Jim Mutch** has gained tremendous respect for the brain through the contemplation of AI problems. He recently completed a Master's degree in computer science at the University of British Columbia where he worked on improving the performance of a biologically-inspired model of visual object recognition. Prior to returning to academia he was a professional software developer. Jim's interests and future course of study are writ broadly; he wants to know how the mind works. A lifelong Vancouverite, Jim could often be found running up local mountains – something he will miss in flat Cambridge.



*L to R women: Rachel Schechter, Caroline Runyan, Lauren Barr, Susan Su
L to R men: Todd Thompson, Greg Hale (back left corner), Josh Sarinana (with glasses), Ben Auerbach, Tim Brady, Mark Howe, Steven Piantadosi, Cheston Tan (white shirt front row), Jim Mutch*

Steven Piantadosi grew up in Baltimore and attended UNC Chapel Hill where he majored in mathematics and linguistics. He is interested in understanding language acquisition and processing from computational and biological perspectives. His hobbies include sailing, scuba diving, reading, and playing accordion on the streets of the North End for money.

Caroline Runyan from Indiana, Pennsylvania went to Allegheny College as an undergrad followed by time in the Laboratory of Neuropsychology at NIMH where she studied neurogenesis in the adult primate. At MIT, she hopes to study cellular and molecular plasticity and their relationship to behavior in the adult.

Joshua Sariñana, a native of the Bay Area and a graduate of UCLA arrived in Boston directly from a vacation in Europe and London. He hopes to build on his extensive research as an undergraduate to study the molecular, cellular, and cognitive aspects of memory, learning, and choice as they relate to consciousness. Aside from neuroscience, Josh is also passionate about photography, philosophy and is more than willing to show anyone his pictures or jump into a discussion on phenomenology.

Rachel Schechter grew up in New Jersey just outside of Philadelphia and attended Rutgers as an undergrad, where she researched regulation of vesicle fusion in yeast, specifically the role of the protein Sec1. Her interest is primarily in cell biology, but one of the reasons she chose BCS was the prospect of being able to learn a little bit of everything. She wants to focus on the neural phenomena that support learning and expects to further narrow her focus as she learns more. Outside of academics, Rachel loves to watch football (the Eagles), play soccer, go to the beach, watch *Lost*, and sleep in.

Susan Su is from Virginia and went to Duke. One unique interest is her study of Southern foods such as sweet tea, North Carolina BBQ, Cajun fried chicken, buttermilk biscuits, and hushpuppies. Susan hope to find a great career (hopefully involving food) after completing the program in cellular and molecular neuroscience.

Cheston Tan is from Singapore, and studied Computer Science at UC Berkeley. After college, he returned to Singapore to serve for 2 years in the military, where he was a lieutenant in a heliborne infantry unit. He is interested in computation in the neocortex, and sees research in vision as a means to that end. He has also dabbled in networking, virtual reality, and bioinformatics. Outside the lab, he enjoys soccer, inline skating and long-distance running (he hopes to run the Boston marathon). Cheston is also interested in management, leadership, and public policy, especially in the areas of education and innovation.

Todd Thompson, who grew up in Texas, took a roundabout route to Cambridge, stopping along the way for undergraduate work at Rice, some IT consulting in Virginia, some field biology at the Point Reyes National Seashore, and some imaging work at Berkeley. At MIT, he is looking forward to studying attention and working memory in humans, and is especially interested in techniques that could enhance those abilities in clinical and normal populations. When not doing research, you will probably find him trying to improve his travel photography or playing any of a variety of games, from poker to chess to obscure German board games.



FACULTY PROFILE: LI-HUEI TSAI

Li-Huei Tsai was not exposed to science while growing up. In fact, her parents worked for the government; her father was a diplomat who represented the Taiwanese government in Japan. She had always dreamed, however, of going to Africa and working with wildlife and so she attended veterinary school in Taiwan. At the time, vets spent much of their time treating farm animals, and by the end of her training Li-Huei was no longer sure that this was the career path she wanted. Seeking more options, she applied to the veterinary sciences department at the UW-Madison. While there, she enrolled in courses that exposed her to molecular biology. She became so interested in this field that she applied to and was accepted by the Ph.D. program at the University of Texas in Dallas. As a post-doc she worked at Cold Springs Harbor applying molecular biology techniques to cancer research under the guidance of Ed Harlow. When Ed Harlow moved to Massachusetts General Hospital in 1990, Li-Huei decided to follow him.

At MGH, Li-Huei began to interact with developmental neurobiologists, particularly pediatric neurologist Verne Caviness. When she finally sought a faculty position it was with the objective of making a fresh start by switching to a

focus on brain development. She joined Harvard Medical School in 1994, working on a mouse model for Alzheimer's, seeking to understand how learning and memory were affected by the disease –



work that she continues today. In 1997, she was named an HHMI Investigator and, after extensive recruiting efforts, was lured to the Picower Institute in early 2006.

Li-Huei, like most highly successful people, is careful in rationing her efforts which perhaps explains why she devotes all of her free time to her family. She and her daughter Jessica are especially close and they engage in many activities such as hiking, fishing, and

biking. Li-Huei believes that a mother should be the ultimate role model, and she freely acknowledges the direction and inspiration she got from her own mother – a relationship she hopes to share with her daughter. She feels that women have an extra burden trying to balance career and family and she is mindful of the fact that everything she does will have a profound influence on her daughter.

When she does allow herself some time away, Li-Huei loves visiting Auckland, New Zealand, where her parents retired. Once or twice a year, if she is traveling to a particularly exotic destination she will try to take her family with her. Other pastimes include reading good novels of any kind, and listening to opera. Mah jong, which she once played with great regularity and at which she was quite proficient, is a continuing interest though often limited to the traditional game on New Year's eve.

Li-Huei considers herself extremely fortunate, finding fulfillment in both work and family. Looking ahead, she believes she is at the ideal site to further develop her research goals. Being surrounded by a visionary group of highly motivated colleagues is perhaps the greatest reward of all – excepting, of course, the many rewards of friends and family.



AWARDS AND HONORS

FACULTY

In July 2006, **Mark Bear** was awarded the William & Enid Rosen Research Award for outstanding contributions to the understanding of Fragile X by The National Fragile X Foundation.

Emilio Bizzi was elected President of the American Academy of Arts and Sciences. His installation was on October 7.

Emery Brown was elected Fellow of the American Institute of Medical and Biological Engineering and Fellow of the American Statistical Association.

Alan Jasanoff was awarded a 2006 McKnight Technological Innovations in Neuroscience Award for his work on cellular-level functional MRI with calcium imaging agents.

Tomaso Poggio was named to the Scientific Advisory Board of the ISI foundation (Turin) and of the Comitato di Esperti dell'ISICT (Genoa).

Molly Potter delivered the keynote speech at the annual meeting of the Psychonomics Society in Houston on November 16. Her talk was titled "Understanding Scenes and Sentences: The Role of Conceptual Short-Term Memory."

STAFF

Administrative Assistant **Bettiann McKay** was given a spot award for her generous assistance to not only her regular supervisors, but others as well.

POST DOCS

Christie Chung was presented with the Brayfield Award for the most meritorious dissertation at Claremont Graduate University. She also won the American Psychological Association Division 20 Proposed Research Award at the post-doctoral level.

BCS SCENES





ALUMNI NEWS

Walter Gillett (M.A. '88) took his degree in Brain and Cognitive Sciences and returned to the software industry as a software engineer. He is now working at ITA Software in Cambridge, an MIT startup, on an airline reservation system. His wife, Sharon Gillett, was a researcher at MIT until recently and has just enrolled at the BU business school to get a DBA in information systems. They have two sons, Max age 16 and Seth age 7.

Frank J. Popper (BS Urban Studies '66) teaches land-use and environmental planning at Rutgers and Princeton. He has a doctorate in political science from Harvard University. He chairs the board

of the Great Plains Restoration Council, has served two terms on the board of the American Planning Association, is on the board of the National Clearinghouse for Frontier Communities, and is a member of the Prairie Writers Circle at the Land Institute in Salina, Kansas, and of the editorial boards of Housing Policy Debate and the Online Journal of Rural Research and Policy. With his wife, Deborah Popper, he originated the concept of the Buffalo Commons as a vision of a sustainable environmental and economic future for the rural Great Plains. He specializes in regional, Western, frontier, and decline planning.

Rose Roberts (PhD '98) is married, with two daughters: Shannon, who will be 4 in November, and Morgan, born June 3 (almost 4 months old). They live near Santa Rosa,

California, about an hour north of San Francisco, and Rose was recently promoted to the position of Division Director of the Ecological Services Division of Circuit Rider Productions, a nonprofit dedicated to preserving and restoring threatened biological systems throughout California.

Mark Sommer (PhD '95) did post-doctoral work at the NEI/NIH Laboratory for Sensorimotor Research, and then, in 2004, became an Assistant Professor in the Dept. of Neuroscience and the Center for the Neural Basis of Cognition at the University of Pittsburgh. He is doing research on the role of feed-back pathways in

the brain during normal behavior and schizophrenia.

Cristina Sorrentino (PhD '98) is the Project Director for Psychopathology and Treatment of Compulsive Hoarding at the BU School of Social Work. She is particularly interested in young children's and adult's assumptions about proper noun syntax vs. adjective syntax as a function of animacy or inanimacy of referent.

Louis Toth (PhD '95) is an Assistant Professor at Boston University School of Medicine in the Dept of Anatomy & Neurobiology. His current research focuses on the coding of information in mammalian cerebral cortex; organization of dorsal and ventral streams in human and primate cortex; and the direct effects of TMS on neuronal tissue.

NEW BEGINNINGS

Assistant Professor James DiCarlo and wife Julie welcomed their first child, a daughter, Mia Ann DiCarlo, on Friday, October 13.

Professor Ted Gibson and graduate student Evelina Fedorenko are engaged and will be married in the spring.

Graduate student Retsina Meyer and her partner, Reuben Goodman, have just become engaged.

Graduate student Terra Barnes and Andy Young, owner of Paragon Interactive, were married on August 12.

Audra Van Wart, a Postdoctoral Associate, was married September 3, 2006 to Greg Valdez, a postdoc at Harvard.

Professor Ted Adelson and Research Scientist Ruth Rosenholz celebrated the birth of their second daughter, Robin on August 25. She joins sister Sarah in their new home.

brain+cognitive sciences

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