brain+cognitive sciences news

Fall 2007

PROFESSORS BROWN AND JASANOFF RECEIVE NIH DIRECTOR'S AWARDS

Department Head Mriganka Sur congratulates Brown and Jasanoff at a reception recognizing their awards

BCS faculty members Emery Brown and Alan Jasanoff were recently recognized by the NIH with Director's Awards which are among the highest honors granted by the Institutes. These special grants were developed to support "exceptionally creative investigators who propose highly innovative approaches that have the potential to produce an unusually high impact."

Emery Brown, who has both MD and PhD degrees, is a BCS Professor of Computational Neuroscience and Health, Sciences and Technology and is one of only 12 scientists to receive a 2007 NIH Director's Pioneer Award. The Pioneer Award is given to scientists who propose pioneering approaches to major challenges in biomedical and behavioral research. Each recipient receives $2.5 million over five years in support of their research.

Professor Brown, will use the award to develop a systems neuroscience approach to studying how anesthetic drugs act in the brain to create the state of anesthesia. This approach to studying anesthesia combines his clinical work in anesthesiology with neurophysiological experiments, use of new signal processing algorithms for data analysis, and mathematical modeling of neural circuits under general anesthesia.

In addition to the Pioneer Award, Brown was also recently elected to membership in the Institute of Medicine, a component of the National Academy of Sciences.

Alan Jasanoff is the N.C. Rasmussen Assistant Professor of Nuclear Science and Engineering with additional appointments in BCS and the McGovern Institute. Alan is the recipient of the 2007 NIH Director's New Innovator Award, which will provide $300,000 per year for five years in support of his work to devise genetically controlled, non-invasive methods for measuring brain activity in animals.

Jasanoff's research seeks to create a new set of neuroimaging techniques that combine MRI's virtues of noninvasiveness and whole-brain coverage with the precision of cellular recording techniques such as electrophysiology and fluorescence microscopy.

The techniques currently under development rely on the use of protein-based sensors that report aspects of neural function and may be targeted to specific cells or cell types.

NEWLY REOPENED MIT MUSEUM FEATURES EXHIBIT OF OLIVA RESEARCH ART

A gala dinner and weekend-long celebration marked the reopening of a renovated and expanded MIT Museum on September 29th. With the new 5,000 sq. ft. Mark Epstein Innovation Gallery, the museum now boasts a street-level entrance and enough space to highlight more of the exciting research that takes place at MIT – including that of BCS Professor Aude Oliva.

Oliva's work is featured in a multi-image display located in the main gallery, a location appropriate to their eye-catching properties. The images consist of superimposed faces that the viewer will perceive as one of two people depending on the viewing distance; stand close and you see one face, step back and it gradually becomes another.

Hybrid images are based on the multiscale processing of images by the human visual system and were originally motivated by masking studies in visual perception. By combining two

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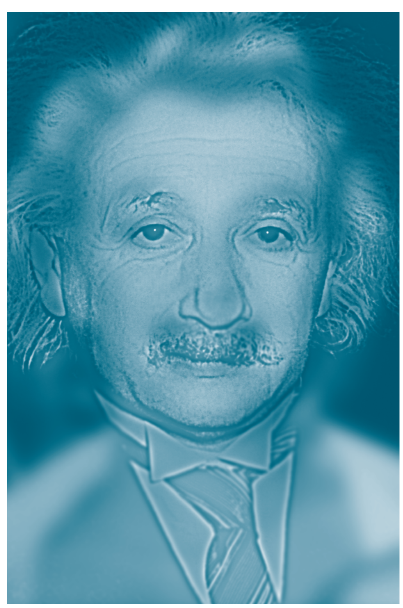

Image: Aude Oliva

Einstein or Monroe?
It all depends on where you stand.

NEWS FROM THE BENCH

Model Demonstrates High Performance in Rapid Categorization Tasks

A new model developed by BCS Professors Tomaso Poggio and Aude Oliva as well as post-doc Thomas Serre has been found to perform rapid categorization tasks at a level equivalent to that of the human brain. The work, which was published in the *Proceedings of the National Academy of Sciences*, could lead to better artificial vision systems and augmented sensory prostheses.

"We created a model that takes into account a host of quantitative anatomical and physiological data about the visual cortex and tries to simulate what happens in the first 100 milliseconds or so after we see an object," explains Poggio. "This is the first time a model has been able to reproduce human behavior on that kind of task." In addition, the model even tends to make errors similar to those made by humans, possibly because it so closely follows

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Massachusetts Institute of Technology

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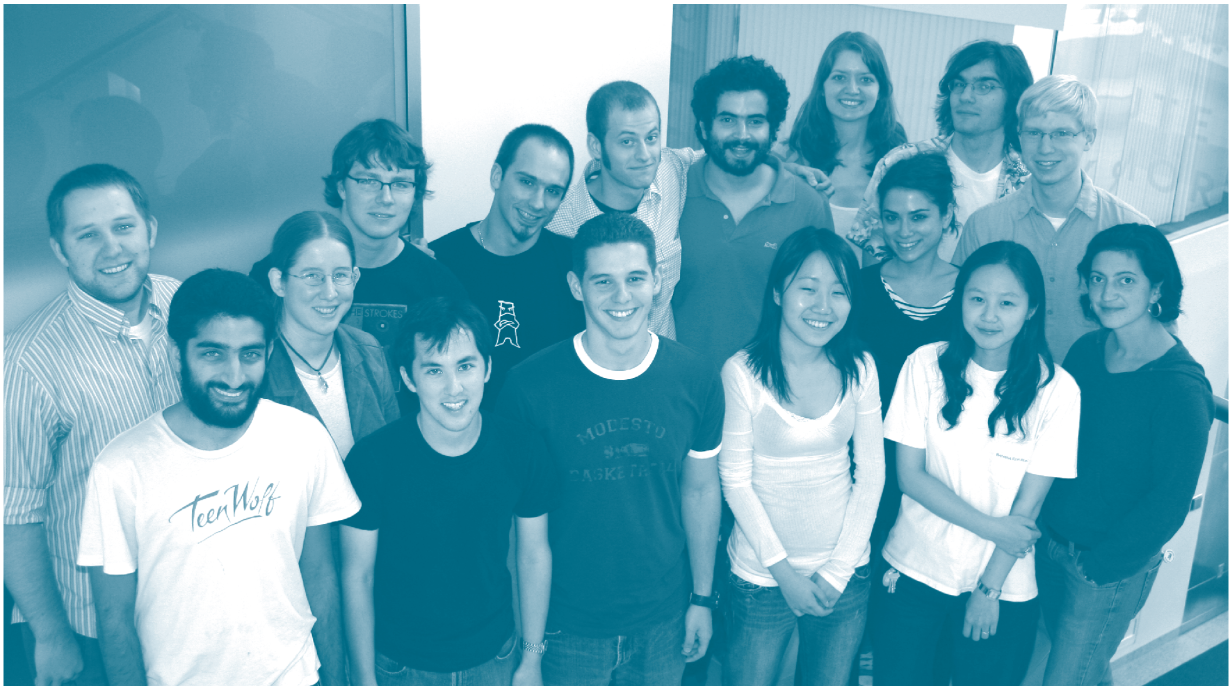
INCOMING GRADUATE CLASS IS ONE OF THE LARGEST EVER



Pictured (l to r): Stuart Layton, Nikhil Bhatla, Krista Ehinger, Andrew Bolton, Bryan Higashikubo, Nicholas Pinto, Yarden Katz (front), David Osher (back), Camilo Lamus, Ni Ji (front), Aline Blunk (back), Zeynep Saygin, Nathaniel Twarog (back), Hyowon Gweon (front) Tyler Perrachione, Claire Cook. Not pictured: Takahiro Soda, Michael Sidorov, Stephen Alkins.

The day after Labor Day was Orientation for the 2007 graduate class in BCS. The 19 new students represent one of the largest classes ever. To help you know them better, we asked each student to provide a brief profile.

Nikhil Bhatla

From: Santa Monica, California
Studied at: Stanford
Major: Product Design with a minor in Computer Science
Research interests: Perception and Consciousness

Aline Blunk

From: Berlin, Germany
Studied at: Free University of Berlin
Major: Biology with concentration in Neuroscience
Research interests: Molecular neuroscience; regulation of synaptic growth
I would most like to have dinner with: Salvador Dali, Charlie Kaufman and Hayao Miyazaki. They symbolize for me what I think is not only important in life but also in research: The success of maintaining creativity and curiosity from childhood onwards as well as examining things not according to the general belief but from alternative viewpoints.

Andrew Bolton

Like to be called: Doctor Bolton
From: Sandwich, Massachusetts
Studied at: Boston Univeristy
Majors: Biomedical Engineering, English
Research interests: NMDA receptor hypofunction in schizophrenia and nutritional therapies for neuroloical disease
My favorite part of the brain is: The ventral tegmental area. As a component of the reward system in the brain, it reinforces my most basic desires to eat and proliferate. In an esoteric sort of way, through my telling you that the VTA is my favorite brain area, my VTA is saying that it likes itself. That the 'like' is somehow reinforced by its ability to gain me basic desires is beyond my understanding. Since I've never waxed poetic about neuroscience to any chefs and walked away with a full stomach for my troubles, you're going to have to refer to my girlfriend for an explanation.

Krista Ehinger

From: Phoenix, Arizona
Studied at: California Institute of Technology and Engineering University of Edinburgh
Major: Psychology
Research interests: Visual cognition, particularly how scene context and target features guide visual search in real world scenes.
My favorite part of the brain is: My favorite part of the brain would be the hippocampus. Mostly because it has a neat shape. Also, I like the Morris water maze experiments and I think the cognitive map theory is interesting. I like the idea of brain cells that "know" where they are in the 3D environment outside of the body.

Hyowon Gweon

Like to be called: Hyo or Hyora
From: Seoul, South Korea
Studied at: Ewha Womans University
Major: Psychology
Research interests: The developmental origins of non-verbal, universal aspects of the human mind, especially causality.
I would most like to have dinner with: If I could only invite some newborn infants over for dinner and hear about what they think and what they see.

Ni Ji
Like to be called: Ni or Ji Ni
From: Nanjing, China
Studied at: Berea College
Majors: Biology and Physics
Research interests: Fear memory and neural circuitry
My favorite part of the brain is: The amygdala because it is believed to generate/regulate the emotion of fear. Because fear plays such a complicated role in our life (it can be both motivating and paralyzing), I am interested in elucidating the neural mechanisms underlying it.

Yarden Katz
Like to be called: Yarden (doesn't rhyme with Garden)
From: Tel-Aviv, Israel
Studied at: University of Maryland
Major: Philosophy
Research interests: Human and machine learning, NeuroCocosci
My favorite part of the brain is: The temporo-parietal junction because it is believed to be responsible for our ability to reason about other minds, the foundational machinery for social cognition. Recent evidence suggests that reasoning about social systems is the first instance of intelligence in our evolution, serving as a kind of prototype for later developments of high-level cognition. It might be that figuring out how social cognition works holds the key for understanding how we acquire theories and concepts more generally, in all domains. This makes the study of the neural basis of social cognition - e.g., the temporo-parietal junction - all the more interesting and important.

Camilo Lamus Garcia Herreros
Like to be called: . . . just Camilo
From: Cucuta, Colombia
Studied at: Escuela de Ingenieria de Antioquia, Colombia
Major: Biomedical Engineering
Research interests: Multimodal functional neuroimaging

Stuart Layton
From: Sandy, Utah
Studied at: Brigham Young University
Major: Neuroscience
Research interests: Effects of anesthesia on hippocampal coding
My favorite part of the brain is: The inferior olivary nucleus. I think it is a really pretty structure and yes, I know it doesn't look anything like an olive.

Tyler Perrachione
From: Kirksville, Missouri
Studied at: Northwestern University
Majors: Linguistics and Cognitive Science
Research interests: Neural and genetic substrates of speech perception, language acquisition and processing
My favorite part of the brain is: I'm very partial to the temporal lobe, particularly the superior temporal gyrus, and am looking forward to a career unlocking its mysteries. I myself have a completely reduplicated left Heschl's gyrus - a convenient extra fold of cortex to help out with all that speech processing!

Nicolas Pinto
From: France
Studied at: ENSISA/UHA and University of Technology
Majors: Artificial Intelligence and Software Engineering
Research interests: High-throughput computational neuroscience and bio-inspired artificial intelligence
My favorite part of the brain is: The visual cortex! Because vision is incontestably the richest sense that we have and goes far beyond the mechanisms of seeing. Vision is striking in its effortlessness as we perceive our visual environment instantaneously and this process does not require us any mental effort, which is another reason why I like the visual cortex!

Zeynep Saygin
From: Istanbul, Turkey
Studied at: Brown University
Major: Neuroscience
Research interests: Developmental functional imaging and plasticity
My favorite part of the brain: I would have to say parieto-occipital areas, because there's more there than meets the eye

Michael Sidorov
From: Rockville, Maryland
Studied at: Northwestern University
Major: Biology
Research interests: Active properties of dendrites, synaptic plasticity
My favorite part of the brain is: The hippocampus - it's importance in learning cannot be underestimated, as it is where all of the hippos go to school. Without the hippocampus, hippos from all over the globus pallidus would be denied an education and would spend their whole lives swimming in pons.

Takahiro Soda
Like to be called: Taka
From: Millbrae, California and Japan
Studied at: UCLA
Major: Neuroscience
Research interests: Molecular biology of psychiatric diseases
My favorite part of the brain is: The claustrum, because it borders the extreme, and no one knows what it's doing there.

Nathaniel Twarog
Like to be called: Nat or "Downtown"
From: Lawrence, Kansas
Studied at: MIT
Major: Course 9
Research interests: Computational modeling of vision
My favorite part of the brain is: Actually I'm not all that interested in the brain. I'm more interested in the mind. I do, of course, recognize that in some sense any action or behavior of the mind is really just the actions and behaviors of the neurons underlying it, but I see them as different topics of study, much like a hurricane and the atoms that comprise it. One certainly can't understand one without an understanding of the other, but you wouldn't want to study the hurricane by investigating the behavior of the individual atoms. Still, the brain is a fascinating thing, and has many remarkable systems. The retina, in particular, is to me quite amazing, with it's incredible information processing power with just five layers of cells.

ALZHEIMER'S: BCS RESEARCHERS TACKLE A COMPLICATED DISEASE

A 70-year-old man shows up at his doctor's office with severe memory loss and difficulty performing routine tasks. He is disoriented and lethargic. Imaging shows that his brain has atrophied. Is he one of the more than 5 million Americans with the age-related, progressive brain disease known as Alzheimer's disease (AD)?

Not necessarily. Because AD manifests itself differently in different people, there is no single test for AD. An estimated quarter of a million developing cases go undiagnosed every year, according to Nature News.

To understand AD's molecular origins, improve its diagnosis and possibly one day prevent or cure it, investigators in the Department of Brain and Cognitive Sciences are harnessing new technologies and integrating results from systems neuroscience, cellular-molecular biology, molecular genetics and advanced statistics.

Suzanne Corkin, professor of behavioral neuroscience in the Department of Brain and Cognitive Sciences, and Li-Huei Tsai, Picower Professor of Neuroscience, explore AD from molecular to systems levels. A recent finding in the Tsai laboratory shows promising results in mice for reversing Alzheimer's-like symptoms.

"There is currently no treatment to stop the progression of the disease in humans," Corkin said. "Many people don't even understand what AD is."

Doctors diagnose AD, which includes symptoms ranging from loss of initiative to dramatic personality changes, only by eliminating other causes of mental decline. But recent results that tie 18 blood plasma proteins to AD patients could lead to a simple diagnostic test.

Gauging the efficacy of this kind of biomarker is one of the ways Corkin, who has been researching AD for 30 years, is now seeking to unravel the twisted threads of symptoms that weave through AD patients.

Corkin directs MIT's Behavioral Neuroscience Laboratory. She and colleagues use behavioral, structural brain imaging (MRI), and functional brain imaging (fMRI) to explore the cognitive and neural basis of learning and memory. "The overarching goal of this research is to identify the cognitive processes that support different kinds of memory in humans, and to relate those processes to specific brain circuits," she said.

Corkin seeks to develop a better way to diagnose AD through these neuroimaging methods; create new cognitive tests based on the real-life deficits of AD patients; identify accuarate biomarkers in blood and urine for AD; and link specific characteristics to specific groups of AD patients in an attempt to identify those, for instance, who have inherited a predisposition to the disease or have other factors in common. "We seek to understand whether the clinical variability in AD is due simply to normal biological variation or to fundamental differences in the disease process," she said.

The Corkin laboratory also is developing and administering behavioral tasks that elucidate the nature and severity of individual AD patients' cognitive deficits, focusing on the cognitive processes that are the hallmark of the disease.

"The results of our work will not only further understanding of the heritable and non-heritable aspects of this disorder, but could provide a springboard for disease-modifying therapies tailored to specific subtypes of AD," Corkin said.

While Corkin looks at neuroanatomical, cognitive, genetic and biomarker data to characterize AD, Tsai explores the disease's manifestations at a molecular level. Just one out-of-step enzyme, she has found, can lead to the diseases' characteristic brain atrophy and neuron loss.

Researchers believe AD--the seventh leading cause of death in the US, according to the Alzheimer's Association--is characterized by the death of brain cells and the formation of plaques--protein fragments called amyloid beta--that build up between nerve cells, and neurofibrillary tangles, twisted fibers of another protein that form inside cells.

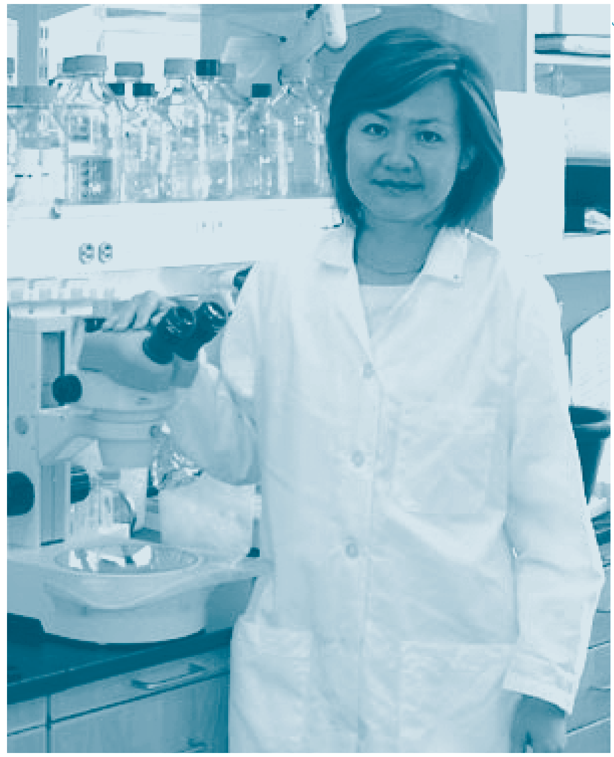


Photo: Cynthia Hensall

BCS Professor Li–Huei Tsai explores Alzheimer's Disease at the molecular level.

For the 5 percent of the population with an inherited tendency toward Alzheimer's, genes are the culprit. But for the 95 percent of the aging population in which the disease arises spontaneously, the role of amyloid beta plaques becomes murkier.

Some people function relatively normally with the amyloid beta plaques nestled among their neurons, but most 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 BCS 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 beloved grandmother's descent into dementia, is determined to unravel some of AD's thorny questions.

A mouse model developed in the Tsai laboratory expands researchers' ability to explore strategies for recovering learning and memory after substantial brain damage had already taken place.

Continued on last page . . .

THE SUMMER SOCIAL

It's late June, the weather's great you, just finished your qualifying exams. That can only mean one thing . . .

Striped shirts are the standard uniform for burger flipping post–docs Patrick Tierney and Ledia Hernanez.

Photos: Henry Hall

Brian DePasquale demonstrates his mastery of the grilling arts.

Michael Long shows off the pitch that made him the most feared hurler in the MIT Summer Softball League.

THE BCS CRUISE

200 BCSers set sail that day for a three hour tour . . . and talk . . . and festivities.

Fear was the subject, but wonder the experience for the audience who listened to Ki Goosen's talk.

The Miller Lab enjoying the perfect weather.

Wide open decks and clear skies made for another successful cruise.

FACULTY PROFILE: KI GOOSENS

It is a statistical probability that any e-mail from Ki Goosens will contain at least one exclamation point – a fact that comes as no surprise to anyone who has ever spent any time talking about neuroscience with Ki. A conversation about her work will begin slowly, almost quietly, but soon adjectives such as "amazing" and "incredible" begin to tumble out in an unstoppable flow. It is absolutely infectious.

The making of Ki Goosens, capital-N Neuroscientist, also began quietly but gathered the same sort of inexorable momentum. Ki, along with her four brothers and sisters, was exposed to the academic life from an early age through her father, who taught philosophy of science at University of Virginia. Soon, however, the realities of raising a large family intruded and he moved everyone to Maryland where he studied artificial intelligence and computer programming, eventually running one of the larger Remote Bulletin Board Systems – an early precursor to e-mail. Although her father's work gave her access to computers at a time when they were not a common household feature, she remembers thinking of them as uncool. "We considered computers really boring – what we really wanted was an Atari like the other kids."

"The first time I heard neurons firing, the hair stood up on the back of my neck."

Her interest in video games notwithstanding, Ki had many ambitions when growing up – all, she later realized, focused on the external world. What she describes as the first in a series of 'Aha!' moments came when she discovered a pair of books in the science section of a local book store. The two texts on molecular neuropharmacology and cognitive neuroscience were heavy reading for a 14 year old, but Ki had discovered an entirely new perspective. "I thought 'This is the greatest unexplored frontier,' and it's inside! That really nailed it for me. I think I read those books at the right time and it showed me something new that I could explore."

Armed with an objective and prepared by a lot of hard work in high school, Ki arrived at the University of Virginia ready to go – except for one thing. "I knew I really wanted to study neuroscience, I just didn't know what it was called." After a first semester of generic math and science, she still had not found the right subjects to take until a friend described the biopsychology course that he was taking. "The second semester of my freshman year I took nothing but biopsychology," she laughs. "It was what I had always wanted to do." She was so excited that she had already bought and read through the entire textbook before her first introductory biopsychology class began.

She sped through UVa in three years graduating as a major in cognitive science with a concentration in neuroscience – a combination that gave her a lot of flexibility in terms of the courses she took. Ki also sought out opportunities for lab work and, after initially being rebuffed as a freshman, she finally landed with a group that was doing electrophysiology. Her first day in the lab was a revelation when she had a direct encounter with her chosen field. "To this day there is nothing more exciting than listening to neurons popping as you move an electrode through a performing brain. The first time I heard it the hair stood up on the back of my neck."

After graduating, Ki worked for two years in several labs at University of Michigan before beginning graduate school. She found the time useful as it allowed her to become familiar with a number of molecular techniques that she had not been exposed to as an undergraduate. Although she toyed with a number of options for her doctoral work, Ki's mind was made up when Steve Maren joined the faculty at Michigan studying fear, learning, and memory. "I just loved the mechanism of fear. It's really robust and easy to study. There's much less ambiguity than in other systems."

Although the results that formed the basis of her thesis were interesting, Ki found herself looking for more sophisticated approaches than the chemical and drug manipulations of her graduate work. "I ultimately found it kind of unsatisfying. People would ask very reasonable questions about the specificity of these manipulations and I was frustrated by not being able to provide a good answer." A talk in her 3rd year resulted in another 'Aha!' moment when she first learned of viral-mediated gene transfer. "It had its own issues, but it's just an amazing tool. It made sense as a way to get around some of the questions I had."

And so Ki came up with a solid plan for her post-doctoral work and took it to Robert Sapolsky at Stanford. "I told him I wanted to combine the power of behavior and electrophysiology with the specificity of viral-mediated gene transfer and I told him I was going to do it in three years." Impressed by the person and the plan, Sapolsky agreed to take her on. "Robert has always shown a lot of flexibility in terms of direction of his lab and even though he didn't directly study fear, what I was doing was pretty consistent with what he was doing," Ki notes.

In her second year at Stanford, Ki began to work on the next thing – an academic appointment. She began her search with low initial expectations. "I thought that I would apply to a few places and hope that I get an interview so I could get some experience with the process." In fact, Ki almost did not apply for an open position in the McGovern Institute because she did not think she stood much of a chance. Fortunately, her partner finally talked her into submitting her application on the last possible day. "I was really surprised when they called and wanted to see me. When I went into the interviews, I decided the best thing to do was just be myself - it took away a lot of the stress."

With her first full year at MIT behind her, Ki has settled into her role as BCS' newest faculty member and the responsibilities of running her own lab. When asked about her activities outside of work, she laughs, noting with no apparent regret that she does not have much available time. Pressed further, Ki will say that, having recently bought a townhouse in East Cambridge, she is excited to have the space to engage in her favorite downtime activity – gardening. But inevitably, the conversation returns to her work and the enthusiasm surfaces again. "This is the brain we're talking about," she says. "What greater frontier is there?"

NEWS FROM THE BENCH

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the organization of the visual system.

The work supports a long-held hypothesis that rapid categorization happens without any feedback from cognitive or other areas of the brain. In other words, rapid or immediate object recognition occurs in one feed-forward sweep through the ventral stream of the visual cortex.

Measuring Clutter

In a recent *Journal of Vision* paper, BCS Research Scientist Ruth Rosenholtz introduced a model for measuring visual clutter, a development that could lead to more user-friendly displays and maps. "We lack a clear understanding of what clutter is, what features, attributes, and factors are relevant, why it presents a problem, and how to identify it," says Rosenholtz.

In the paper, Rosenholtz, BCS graduate student Yuanzhen Li and BCS undergraduate Lisa Nakano--tested the influence of clutter on searching for a symbol in a map, like an arrow indicating "you are here." They found good correlation between the time it takes to find a symbol in a map and the amount of clutter according to their measure.

Cluttered or not cluttered? Now your computer can decide for you.

The new model, which incorporates data on color, contrast, and orientation, has been incorporated into a MATLAB-based tool that can be used to generate "clutter maps" to gauge the level of clutter of a display. The tool is available for free on the MIT Libraries web site. Rosenholtz next plans to offer this visual clutter tool, as well as other tools developed in her lab, to designers as part of a user study. She hopes to learn what insights designers get from understanding how a user will perceive their designs, and how best to present this information to the designers.

Maturity brings richer memories

BCS Professor John Gabrieli and post-doc Noa Ofen report in *Nature Neuroscience* that while adults and children have a similar capability to form basic memories, adults do better at remembering context and details, resulting in richer memories.

The study indicates that a more developed prefrontal cortex may be responsible for creating these richer memories. "Activation in PFC follows an upward slope with age in contextual memories. The older the subjects, the more powerful the activation in that area," explains Gabrieli. "That makes sense, because there's evidence that PFC develops later than other brain regions. But this is the first study that asks how this area matures and contributes to learning."

For the study, Ofen used fMRI to record brain responses as volunteers tried to commit pictures to memory. They were then shown a much larger group of images and asked to select the remembered pictures from the larger group. In both children and adults, several areas in the PFC and the medial temporal lobe showed higher activation at the time when subjects studied a scene they would later remember. The brain scans also showed age-related differences in activation in PFC when the subjects looked at pictures that were correctly recognized. In older subjects, correct answers were also more frequently enriched with contextual detail.

When looking at this result in more detail, Ofen found that the enriched memories also correlated with more intense activation in a specific region of the PFC. Ofen explains, "Our findings suggest that, as we mature, we are able to create more contextually rich memories, and that ability evolves with a more mature PFC."

Tinkerer, Teacher or Both?

In a series of experiments whose results were published recently in *Neuron*, BCS Professors Bizzi and Seung, along with lead author post-doc Uri Rokni have found that neural activity in the brain gradually changes, even when nothing new is being learned. The researchers believe their findings suggest a new theory of how the brain learns.

The work expanded on earlier experiments by Bizzi and colleagues who measured neural activities in the motor cortex while monkeys manipulated a handle to move a cursor to targets on a screen. In control experiments, the monkeys had to move the cursor to targets in the same way they had been trained. In learning experiments, the monkeys had to adapt their movements to compensate for novel forces applied to the handle.

The scientists found that even when the monkeys were performing the familiar control task, their neural activities gradually changed over the course of the session.

To explore the significance of these background changes, Rokni analyzed the data from the learning component of Bizzi's experiments. He found he could distinguish learning-related neural changes from the background changes that occurred during the control experiments. From this analysis, Rokni developed a working theory that combined the concepts of a redundant neural network and that of a "noisy" brain.

Rokni explains that "learning in the brain has two components - error-correction and noise - so that even though the neural representation keeps changing, the behavior remains fixed. We think the tinkerer, that is the noise, is not merely a nuisance to the teacher but is actually helping the teacher explore new possibilities it wouldn't have considered otherwise."

To test this idea, Rokni constructed a mathematical model of a redundant cortical network that controls movement and used it to simulate the learning experiment with the monkeys. In this model, learning of the connections between neurons was assumed to be a considerably noisy process. "When we ran the simulation long enough, the performance became good, but the neural representation kept changing, very similar to the experiments," Rokni said.

Rokni believes that these results have important implications for neurobiology. "I don't think this concept of redundancy--that the brain can say the same thing in different ways--has really been fully appreciated until now," he said. "More practically, people who are constructing devices that translate brain signals to operate such external devices as neural prostheses will have to take such constantly changing neural representations into account," said Rokni.

ALZHEIMER'S: BCS RESEARCHERS TACKLE A COMPLICATED DISEASE

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Tsai's innovative mouse model exhibits the onset of Alzheimer's symptoms in a fraction of the time previously possible. The transgenic mouse's expression of p25, a protein implicated in various neurodegenerative diseases, can be switched on or off with a change in diet. Mice that expressed the p25 protein have significant loss of brain cells and do not remember tasks they had previously learned.

Tsai also focuses on a kinase (kinases are enzymes that change proteins) called Cdk5. Cdk5, paired with the protein p35, helps new neurons form and migrate to their correct positions during brain development. But Cdk5, paired with the aberrrant p25, also is implicated in age-related neurodegenerative diseases.

"There are still a lot of unknowns," said Tsai, who is also a Howard Hughes Medical Institute investigator. "I think causes for psychiatric disorders and age-related neurodegenerative disorders are still very much unclear."

In a recent, widely reported finding from the Tsai laboratory, genetically altered mice whose brains had atrophied like those of Alzheimer's disease patients regained long-term memories and the ability to learn after living in an enriched environment. The same results also were achieved with a new experimental class of drugs.

Tsai and colleagues had found that being exposed to stimuli that enhanced the animals' well-being induced their neurons to sprout new connections.

"This is exciting because our results show that learning ability can be improved and 'lost' long-term memories can be recovered even after a significant number of neurons have already been lost in the brain," said Tsai. "This hints at the possibility that cognitive function can be improved even in advanced stages of dementia."

The BCS researchers' multiple approaches increase the odds that AD diagnosis and treatment will improve dramatically in the not-too-distant future.

MIT MUSEUM FEATURES OLIVA'S WORK

Continued from front page . . .

images with two different spatial scales - a low spatial scale created by filtering one image with a low pass filter and a high spatial scale obtained by filtering a second image with a high pass filter – the result is a picture whose interpretation changes with viewing distance.

Oliva first developed these images in the 1990s with Philippe Schyns at the University of Glasgow. The technique can be applied to create pictures that change with viewing distance, to display two configurations of a scene in a single picture, and to present textures that disappear when viewed at a distance. Hybrid images are especially effective for creating images of faces that change expressions, identity, or pose. The original hybrid images were refined over time, with the notable assistance of CSAIL Professor Antonio Torralba, to produce the more enduring and reversible illusions featured in the museum exhibit.

The exhibit entitled *Eight Einsteins* will be on display at the MIT Museum until September, 2008. All of the images have a picture of Albert Einstein rendered in a high spatial frequency meaning that it is visible at short viewing distances; from further away eight different famous figures appear. The series was created by Oliva, Torralba, and Amanda O'Keefe.

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