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bcs news

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Technology

contents

brain+cognitive sciences

A Message from the Department Head
Mriganka Sur

BCS research initiatives are having significant MIT-wide impact

In this issue, I am pleased to bring news of some of our outstanding faculty and students, and upcoming events that define our research vision. In a special profile, you will learn about Richard "Dick" Wurtman, M.D., the Cecil H. Green Distinguished Professor Emeritus and Professor of Neuroscience, who retired in January 2011 after 44 years at MIT. On March 22, the Department of Brain and Cognitive Sciences held a special symposium entitled "Foods, Drugs and Neurotransmitters: Mapping Mechanisms in Brain Chemistry", to celebrate Dick Wurtman's career and his many contributions to science.

You will also meet Myriam Heiman, a new junior faculty member who joined BCS in January. Myriam holds joint appointments in the Picower Institute for Learning and Memory at MIT and the Broad Institute. She is studying properties of individual cell types in the complex environment of the brain, offering new ways to study the functional implications of genetic variation on psychiatric and neurodegenerative conditions, specifically using mouse models of Huntington's disease, Parkinson's disease, and schizophrenia. She would like to determine why certain cells — and not all cells in the nervous system — are most affected in diseased states.

The graduate admissions cycle each spring is one of the most significant in the Department's annual calendar. With the most recent cycle just concluded, I am pleased to report that this year's applicant pool was again strong. Our recruiting program benefits not only from the dedicated efforts of our faculty, staff and students, but also from exposure to the collaborative training and research opportunities that our faculty can offer. The outstanding record of our graduate students in obtaining external graduate fellowships continues: this year, 4 students have been awarded NSF fellowships, bringing our total number of students with external fellowships to 33 (of 97 students).

The BCS Education Committee led by Matt Wilson has undertaken significant changes in the undergraduate and graduate programs over the past year. We continue to refine the curriculum, with the goal to increase the quality, rigor and value of our programs. Education remains core to our overall mission; an MIT education, of course, draws as well on a rich research community.

Our research vision is shaped by the central role our fields have within MIT. Neuroscience and cognitive science have the potential to influence, and be influenced by, many elements of engineering and science. The Intelligence Initiative (I^2), led by BCS faculty Tomaso Poggio and Joshua Tenenbaum, represents a fresh, new approach to the question of intelligence. This spring, I^2 supported eleven collaborative seed projects across all MIT schools, and is hosting a special symposium entitled 'Brains, Minds and Machines' as part of MIT's 150th anniversary celebration, on May 3-5, 2011. The Brain Disorders Initiative is having significant MIT-wide impact through programs such as the Simons Initiative on Autism and the Brain, and is hosting a mini-symposium entitled 'An Afternoon with MIT's Brains on Brains' on April 25, showcasing progress by MIT researchers on revealing the mechanisms of neurodevelopmental and neurodegenerative disorders.

I would like to close by acknowledging the wonderful turnout at our biennial meeting of the BCS Visiting Committee on April 26-27, 2011. We are grateful for the deep personal interest and commitment of each member, and for their collective vision and attention towards sustaining the excellence of our Department.

Editor
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On the Cover
Negative photomicrograph of brain section, with clustered activated neurons enhanced for greater contrast. Researchers in Ann Graybiel's lab have found that drugs of abuse activate reward centers in the brain and drive repetitive behaviors. The severity of these drug-induced repetitive behaviors is directly correlated with preferential activation of neurons in the striosomal compartment of the striatum. Please see more about Ann Graybiel in the article on page 4.

Mentoring Yields Highly Competitive Graduate Fellowships for BCS Students

Brain and Cognitive Sciences graduate students are increasingly successful in competing for and receiving eminent graduate research fellowships. This year, BCS students distinguished themselves by receiving highly competitive awards from among the leading national and international scientific agencies and foundations, including the National Institutes of Health, the Autism Science Foundation, and the International Fulbright Science and Technology Award, among others.

Three BCS students hold National Defense Science and Engineering Graduate (NDSEG) Fellowships, a three-year graduate fellowship awarded annually from the Department of Defense (DoD) to approximately 200 top U.S. students who demonstrate the ability and special aptitude for advanced training in science and engineering.

Eighteen current BCS students are among the nation's best young scholars who hold awards from The National Science Foundation's Graduate Research Fellowship Program (GRFP), which provides up to three years of support for study leading to research-based master's or doctoral degrees and are intended for students in the early stages of graduate study. The NSF Graduate Research Fellowship Program invests in graduate education for a select group of individuals who demonstrate their potential to successfully complete graduate degree programs in disciplines relevant to the mission of the NSF in science, technology, engineering, and mathematics in the United States. Each year, approximately 1,000 new NSF three-year graduate fellowships are awarded.

Rodrigo Garcia, graduate student in BCS, recently won a graduate research fellowship from the National Science Foundation. Garcia is researching structural plasticity and neuronal-astrocyte interaction in the visual cortex in sensory deprivation protocols. Image: Brain and Cognitive Sciences

"The support provided by these fellowships to up-and-coming young researchers is really critical in helping them to reach their full potential," said Dr. Mriganka Sur, Department Head for Brain and Cognitive Sciences and Newton Professor of Neuroscience. "These awards will enable many of these students to move on to amazing careers in their chosen fields."

As faculty research adviser to BCS graduate student Rodrigo Garcia, who recently won an NSF Graduate Research Fellowship, Sur knows that the student's experience gained in applying for this external funding is in itself a valuable part of their professional preparation. "These prestigious fellowships prepare students for the long term to spearhead neuroscience research projects, and to network both domestically and internationally within the scientific community," said Sur. "This year's new group of BCS students with NSF Graduate Research Fellows and other awards are another outcome of the wonderful relationships between faculty and undergraduate and graduate students possible in BCS." Sur points to Professors Dr. Ki Ann Goosens and Dr. Aude Oliva as one starting point and a driving force behind helping these students to accomplish successful fellowship applications.

Laura D. Lewis, a third-year graduate student in BCS, won a graduate research fellowship from the Canadian Institute of Health, which she will use to continue her studies on the effects of anesthesia and brain function with faculty advisor Dr. Emery Brown. Image: B. Vejvoda

Mentoring Success

Four years ago, Goosens and Oliva developed the well-regarded Fellowship Application Seminar in BCS to provide another level of mentoring for students. The goal is to offer assistance to students who would like to improve their writing and increase their skills in seeking external research funding.

"Our seminar can help students lay out a plan for developing a long-term project, search for funding venues, and prepare a successful application for submission to prestigious research award agencies," said Goosens. "Their commitment to pursue the important research questions makes these students an example of the experimental neuroscience scholars that the department seeks to encourage and promote."

Goosens recalls the tough life of a graduate student. "Demands on students are high, the course work is a challenge, technology is difficult and there's lots of writing," Dr. Goosens said. "My mentors were critical to me in preparing me for the career I have today."

So, together with Dr. Aude Oliva, she has guided, counseled and collaborated with more than 40 graduate students and gets excited with them when their funding applications are recognized and awarded.

BCS third-year graduate student Laura Lewis also knows the importance of a good mentor. Before graduating from McGill University in 2008, Lewis worked with her undergraduate faculty advisor to pursue a graduate fellowship that enabled her to begin her doctoral studies at MIT. Lewis, a Montreal native, is the recipient of two prestigious national Canadian research fellowships. ""Applying to these awards improved my focus and commitment to my research ideas, and I believe they improved my grad school application."

Rodrigo Garcia, a native of Nicaragua and Florida, began his lab rotation with Dr. Sur at the outset of his doctoral studies in BCS. "I am honored to receive my NSF Graduate Research Fellowship. It is a fantastic opportunity to pursue graduate-level education and research, and to build upon the strong foundation that I have received at MIT," said Garcia.

"We are proud of these students and of our faculty, who provide excellent mentoring, research opportunities and encourage students to pursue external graduate research fellowships," said Sur.

Faculty Profile: Myriam Heiman

As an undergraduate at Princeton, Myriam Heiman for a time envisioned herself as a classics professor. She admired Cicero's linguistic artistry, but she ended up choosing living cells to ancient texts. Nevertheless, Cicero's take on the mind-body connection was remarkably prescient. "In so far as the mind is stronger than the body," he wrote, "so are the ills contracted by the mind more severe than those contracted by the body." Heiman, who joined MIT in January as assistant professor of neuroscience for the Department of Brain and Cognitive Sciences (BCS) and the Picower Institute for Learning and Memory, hopes to shed light on ills such as Parkinson's and Huntington's disease which, while based in the brain, have far-reaching effects on the body.

Heiman captures complete genetic profiles of living neurons at a moment in time, which she hopes will shed light on how brain cells differ in normal and diseased states and potentially point to new drug targets for neurodegenerative diseases.

"Myriam's appointment exemplifies a new era for BCS in which faculty pursue active research partnerships and collaborations around neuroscience and brain disorders at MIT with world-renowned genomics research centers such as the Broad Institute and with leading clinical research centers," said Department Head Mriganka Sur. " As a result, our faculty and students will have the tools and approaches to draw on other fields and derive meaningful answers to our most profound questions about how the human brain works.

"Further, new technologies and knowledge of genomics and brain mechanisms will change the way we treat brain diseases and disorders," Sur said.

Snapshots of living cells

Oliver Sacks's book *Awakenings* (and the 1990 movie based on it) vividly portray the effects on Parkinsonian symptoms of the drug L-dopa, which the body metabolizes into the neurotransmitter dopamine. Yet researchers don't fully understand what happens in the ravaged brain from drugs such as L-dopa, which can be remarkably effective and then lose their efficacy and spawn serious side effects. Or why, in many neurodegenerative diseases, certain groups of cells die before others.

Neurons are harder to study than other cells, Heiman pointed out. A slice of brain tissue consists of a tangled web of cells whose elaborate architecture and intermingling of types makes individual cells difficult to extract and study. "While we know a lot already about many types of neurons, there are many other cell types in the brain we don't know much about at all," said Heiman, a core faculty member of the Broad Institute. In this category are the medium spiny neurons that make up 96 percent of the striatum, an inner part of the forebrain and the major input station of the basal ganglia.

The striatum is important in movement, cognition, motivation and reward, and emotional control--all of which go awry in diseases such as Parkinson's. There are two main kinds of neurons in the striatum that snake their axons through different brain regions and seem to respond differently in disease states. Among the leading researchers who have studied these neurons are MIT biologist David E. Housman and neuroscientist Ann B. Graybiel, both of whom Heiman now feels privileged to count among her senior colleagues.

Heiman uses new genetic techniques to study these cells that allow her to profile their inner workings in a much more sensitive way than previously possible. A methodology called Translating Ribosome Affinity Purification (TRAP) allows ribosomes translating proteins to be tagged like migrating birds. Using the molecular tags, the scientists can separate and purify all the messenger RNA — representing which proteins are being made in the cell — from a single cell type, resulting in a snapshot of protein translation in a given living cell in a functioning circuit at a given time. "We haven't had this kind of molecular access before," Heiman said.

Seeing inside

In her accelerated three years at Princeton, in addition to studying the classics, Heiman studied the genetics of bacteria; then, as a graduate student at Johns Hopkins, the genetics of yeast. As a postdoctoral researcher at Rockefeller University under Nobel prize-winning molecular and cellular neuroscientist Paul Greengard, Heiman moved on to mouse models and was struck by how challenging it was to pick out individual cells in the structurally complex nervous system of higher organisms. She wished there was a way to "see" the molecular workings of neurons as clearly as the relatively transparent operations of single-celled creatures.

Greengard's interdisciplinary lab allowed Heiman to combine her interests in genetics, biochemistry, and cell biology on the ribosome-tagging technique, which, used in conjunction with mouse models of Huntington's and Parkinson's disease, is a powerful tool to determine why some cells are more vulnerable than others and what role genetic variants play in disease.

In addition, Heiman's appointment at the Broad connects her to the Stanley Center for Psychiatric Research, which focuses on genetic risk factors for bipolar disorder and schizophrenia, another major interest of Heiman's.

"Myriam exemplifies the ways in which faculty pursue active research partnerships and collaborations around neuroscience and brain disorders at MIT with world-renowned genomics research centers such as the Broad Institute and with leading clinical research centers."

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Research Portfolio: Blind Children in India Help Answer a Three-Hundred Year Old Question

For most scientists like Pawan Sinha, the societal benefits of their enterprises are realized long after the research effort. But Sinha's Project Prakash is different. Sinha, Professor of Vision and Computational Neuroscience, is merging science and service in Project Prakash to help provide curably blind children in India with access to eye care and surgery. In the process, the study of patient outcomes is illuminating fundamental scientific questions about how the brain develops and learns to see.

Project Prakash

Blindness takes a heavy toll in India, where the rate of childhood blindness is three times that of Western nations. Half of India's blind children die before the age of 5, and nearly all those who survive childhood are uneducated and unemployed. Most cases of blindness in India are caused by vitamin A deficiency, cataracts, retinal or optical dystrophies, or microphthalmos (poorly developed eyes). About half of these cases are treatable or preventable, but many blind children never receive medical care.

Sinha founded Project Prakash in 2004 to help find and treat these blind children. "There's a humanitarian need to tackle this problem, and in addressing this humanitarian need we also have the opportunity, as neuroscientists, to understand how the brain learns to make sense of its visual environment," says Sinha. Since that time, Pawan and his graduate students have organized outreach, treatment and research study infrastructure to make headway towards the Prakash initiative's humanitarian and scientific goals. To date, over 20,000 children have been screened and treatment provided to over 700 individuals. The transportation, treatment, hospital stay and follow-up examinations are entirely free of charge for the children, supported by NIH, private foundations and individuals. While treatment has brought dramatic changes in the lives of these children, the scientific data gathered in the process have begun challenging some long-held dogmas in neuroscience about learning and brain plasticity.

Pawan Sinha screens and tests children for Project Prakash in a village in India.Image: Pawan Sinha

Philosophy meets Neuroscience

Project Prakash has yielded several insights into visual learning. Most recently, the Prakash researchers have succeeded in answering one of the most famous and long-standing questions in the philosophy of mind — the Molyneux query. As described in John Locke's 'An Essay on Human Understanding' in the 17th century, the question is elegantly simple to state: Imagine a person blind from birth who abruptly gains sight in adulthood. Immediately after the onset of sight, would he be able to visually discriminate between objects that he could previously identify by touch?

Over the past three centuries, this question has been the subject of numerous debates in philosophy and neuroscience. Its importance is widely acknowledged since it touches upon philosophical issues of nativism versus empiricism (the nature/nurture question) and also deep scientific questions regarding the extent of communication between different sensory modalities (Do the various senses share an innate common space?). "Molyneux's problem is one of the most fruitful thought-experiments ever proposed in the history of philosophy." according to the Stanford Encyclopedia of Philosophy.

Efforts to answer the question began not long after its original posing in 1688. However, because of the difficulties of the sight-restoration procedures and their dubious sequelae, the question had thus far remained unresolved. The Prakash team had an opportunity to answer it by working with congenitally blind individuals to whom they were able to provide corrective surgeries. In studying their post-operative

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Graybiel Honored with the 2011 Hans-Lukas Teuber Memorial Lecturer

Image: Brian Malloy

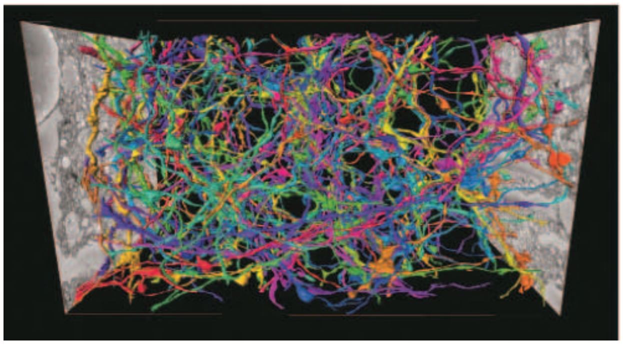
Ann M. Graybiel, Institute Professor in the Department of Brain and Cognitive Sciences and the McGovern Institute for Brain Research, was named the Hans-Lukas Teuber Memorial Lecturer this spring. Her talk was titled The Basal Ganglia: Binding Values to Action. Speakers are selected by a small group of graduate students in conjunction with a faculty member from distinguished members among the neuroscience and cognitive science community nationwide. Known for her prolific and highly respected research, Dr. Graybiel is also honored for her remarkable ability as a teacher — attributes that are celebrated in the life and work of Dr. Teuber. The Hans-Lukas Teuber Memorial Lecture is made possible by the Robert K. Yin Fund.

BCS Faculty Breakfast Talk Series: Mapping the Connectome with Sebastian Seung

Last Fall, Sebastian Seung spoke at the popular *BCS Faculty Breakfast Talk* series for supporters and friends of Brain and Cognitive Sciences. Sebastian, Professor of Computational Neuroscience, is also appointed to the Department of Physics, as well as an Investigator of the Howard Hughes Medical Institute. Seung's talk *Connectome: The Quest to Deconstruct the Brain* drew a large audience curious to learn about the emerging field of connectomics.

Connectomics attempts to physically map the tangle of neural circuits that collect, process, and archive information in the mammalian nervous system. Such neural maps could ultimately shed light on the early development of the human brain and on diseases that may be linked to faulty wiring, such as autism and schizophrenia. "The brain is essentially a computer that wires itself up during development and can rewire itself," says Seung. "If we have a wiring diagram of the brain, that could help us understand how it works."

Although researchers have been studying neural connectivity for decades, existing tools don't offer the resolution needed to reveal how the brain works. In particular, scientists haven't been able to generate a detailed picture of the hundreds of millions of neurons in the brain, or of the connections between them. Seung ultimately hopes the aid of new imaging and computational technologies his lab is developing to illuminate and map the vast web of neural circuits will help scientists better understand brain development and disease.



Neural wiring of the rabbit retina reconstructed using technologies developed specifically for the emerging field of connectomics. Image by Viren Jain, Srinivas Turaga and Sebastian Seung from MIT, and the laboratory of Winfried Denk, MPI-Heidelberg.

Noteworthy

FACULTY

Joshua Tenenbaum is a recipient of the National Academy of Science's Troland Award for 2011. Tenenbaum was recognized for formulating a groundbreaking new Bayesian model of human inductive learning and for using this model to generate innovative empirical studies of human perception, language and reasoning.

Laura E. Schulz received the 2010 Presidential Early Career Award for Scientists and Engineers (PECASE). The award recognizes and supports research funding for outstanding scientists and engineers who show exceptional potential for leadership in scientific research at early stages of their careers.

Laura also received the 2011 Society for Research in Child Development Award for Early Career Research Contributions.

Peter Schiller has been selected to receive the Jay Pepose '75 Award in Vision Sciences from Brandeis University.

Edward Boyden received the 2011 National Science Foundation CAREER Award.

Yingxi Lin received the 2010 John Merck Scholar Award.

Susumu Tonegawa was honored with the 2010 David M. Bonner Lifetime Achievement Award at University of California San Diego.

STUDENTS

Graduate student **Charles Frogner** was awarded a Department of Energy Computational Science Graduate Fellowship (DOE CSGF) for his work using high performance computing to solve complex problems in areas of computational biology.

Graduate students **Gerald Pho**, **Elizabeth Gutierrez Roman**, **Eyal Dechter**, and **Leon Bergen** were named recipients of a 2011 National Science Foundation Graduate Research Fellowship.

Michael Sidorov, fourth year graduate student, was awarded the 2010 Autism Science Foundation Doctoral Training Award for his investigation of postnatal drug intervention for its potential in rescuing the symptoms of Fragile X syndrome in adult mice.

Claire Cook, also a fourth year graduate student, received the 2010 Elizabeth Munsterberg Koppitz Child Psychology Graduate Student Fellowship by the American Psychology Foundation.

STAFF

BCS Senior Administrative Assistant **Eleana Ricci** received the 2011 School of Science Staff Excellence Award.

Richard Wurtman, MD, a Pioneer in the Study of Nutrition and the Brain, Retires from MIT

Guest speakers at Foods, Drugs and Neurotransmitters: Mapping Mechanisms in Brain Chemistry, a special symposium held last February honoring Dick's many contributions to science. Panelists included former Wurtman Lab graduate students, colleagues and BCS faculty. From left to right: Irina V. Zhdanova, M.D., Ph.D.; Steven H. Zeisel M.D., Ph.D.; John Herbert Growdon, M.D.; Bertha K. Madras, Ph.D.; Ki Ann Goosens, Ph.D.; Richard Wurtman, M.D.; Judith J. Wurtman, Ph.D. and Timothy J Maher, Ph.D. Image: Brian Malloy Photography

After 44 years at MIT, Richard Wurtman, M.D., Cecil H. Green Distinguished Professor Emeritus and a Professor of Neuroscience in Brain and Cognitive Sciences, is "retiring" … but he will not be reclining in the easy chair. He intends to usher his laboratory's discoveries related to neurodegenerative diseases and brain injuries onto the clinical stage; write about "the philosophy of neurochemistry"; teach an MIT course; and continue his involvement with the Boston Symphony Orchestra and other cultural institutions – without skipping his daily gym routine.

"Throughout his career Dick has sown the seeds of science, reaped the harvest, and then taken the additional step of making sure that that harvest is delivered to a world hungry for its fruit," said BCS Professor Matt Wilson following a March 22, 2011 symposium honoring Wurtman.

The metaphor is apt, because Dick has shown how nutrients affect the neurotransmitters in the brain that influence our appetite – and mood, sleep, behavior, and cognition. He and his associates have turned such discoveries into products that, among other things, quell carbohydrate cravings and insomnia.

Wurtman received an M.D. from Harvard Medical School in 1960 and trained at Massachusetts General Hospital before joining Julius Axelrod's National Institutes of Health lab in 1962 to engage in a new way of studying the brain, relating particular neurotransmitters to diseases and the effects of drugs. In 1967 MIT invited him to start a neurochemistry and neuropharmacology program in the Department of Nutrition and Food Science, at that time the only department in the School of Science that studied biological entities larger than cells.

That placement was fortuitous because it "sensitized me to the fact that nutrients are chemicals the way drugs are chemicals," Dick said. "A compound like folic acid is a vitamin in foods, but when given alone in higher doses it becomes a drug that safeguards the developing nervous system."

In the 1980's, MIT formed the department of Brain and Cognitive Sciences, merging the psychology department with neuroscientists like Dick. That too was fortuitous, giving his lab access to colleagues – like the neuroanatomists Walle Nauta and his protégé Ann Graybiel (now an MIT Institute Professor), and the animal psychologist Gerald Schneider – who trained his students in relevant experimental approaches. Sue Corkin taught him about measuring changes in cognition and behavior. BCS faculty Susumu Tonegawa, Nancy Kanwisher and others showed him the implications of genetics and neuroimaging for understanding the human brain. All along, Dick published some 1,000 papers and trained 300-plus graduate students and post-doctoral researchers.

In addition, Dick was involved in the NIH-established Clinical Research Center (CRC) at MIT, which he also directed for 20 years. CRCs exist in universities to facilitate the translation of basic research findings into products beneficial to human health. Dick does this by a three-step process: first, in the lab, discovering an unsuspected biochemical relationship; then determining whether that relationship exists in people; then asking whether it could underlie a new treatment for a disease or condition. The new treatment usually involves a new use for an "old" drug, or a nutrient, or a hormone like melatonin.

For example, Dick's lab discovered that eating carbohydrates raises the amount of tryptophan in the brain, which raises the level of the neurotransmitter serotonin, which then reduces appetite. With Judith Wurtman, his wife and an MIT research affiliate, he showed that low serotonin, whether caused by low-carb diets, depression, or PMS, encourages carbohydrate binges as "self medication." They developed Serotrim, a product with carefully measured carbs to raise brain serotonin and reduce appetite, and later Sarafem, the first drug for severe PMS, which contains fluoxetine (Prozac), an antidepressant that increases the availability of serotonin in the brain.

Dick also discovered that melatonin is a hormone that regulates sleep; that several neurotransmitters and chemical messengers modulate the formation of the abnormal peptide, A-beta, in the amyloid plaques characterizing Alzheimer's disease; and that giving choline, tyrosine, or glutamine, the dietary precursors of the neurotransmitters acetylcholine, dopamine, and GABA, can increase their levels in the brain and affect behavior.

Recently, he showed that three nutrients – DHA, choline and uridine – affect the rate at which neurons build the membranes of synapses, the structures that connect neurons and are important in cognition. Increasing brain levels of these precursors enhances the formation of synapses. Dick recognized that a loss of synapses causes the cognitive problems in neurodegenerative diseases like Alzheimer's and Parkinson's and, probably, after brain injuries resulting from stroke, multiple concussions in athletes, and combat-related brain trauma. So he developed a composition containing these nutrients, which is currently being tested in Alzheimer's patients.

"The basic research is easy," Richard said. "The hard part is developing a product that patients can take." Sounds like a perfect retirement project for him.

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Faculty Profile: continued

A moving target

Heiman's mother is a psychologist and her father a petrochemical engineer, setting her up for exploring the workings of the brain with a scientific edge. Watching her older brother take a series of medications to treat his schizophrenia made her wonder how drugs work in the brain. "Many of these drugs were identified by accident and have been around a long time, but no one knows exactly how they work," she said. Maybe, she thought, scientists could develop better versions of existing drugs if only they knew more about how specific cells responded to different compounds.

Her father's career led the family to move every three or four years—Heiman lived in New Jersey, Texas and Canada—so her past seven years in New York became the longest she'd spent in one place. The opportunity to work with Greengard was a stroke of incredible good fortune, she said. "He's an incredible scientist," she said; the single person who has had the most influence on her career.

Heiman doesn't regret choosing life sciences over Latin. She discovered early on that hands-on bench work suits her better than the internal world of the classicist. "What I really like about science is pursuing truth--getting as close to truth as you can. Science gives us the ability to discover something fundamental and true," she said. More than two thousand years after Cicero wrote, "The intellect engages us in the pursuit of truth. The passions impel us to action," it seems like Heiman is doing exactly what he had in mind.

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Research Portfolio: continued

vision, the researchers found the answer to the Molyneux query. And the outcome has been a surprise — one that has important implications for organization across the sensory modalities and for theories of how the brain learns to acquire a coherent account of the complex environment.

In brief, the initial acquisition of vision is not accompanied by visual recognition of objects known by touch. But that ability is acquired within days of recovery of vision, strongly suggesting that the potential for crossmodal identity is present but requires a short period of exposure to potentiate the capability. Recent studies of neuronal mechanisms are in accord with this account. Many more results from the Project have already appeared or are in the pipeline with implications that range from a basic understanding of the brain to insights regarding developmental disorders like autism. A paper describing the Molyneux query results is scheduled for publication in Nature Neuroscience this spring.

The magnitude of the problem of childhood disabilities in India is daunting, and the challenge of unraveling brain mechanisms of learning is also amongst the hardest in science. Much work remains to be done, but Project Prakash has begun to serve as a nucleus for bringing together the resources, expertise and commitment needed to mount a response.

"The Molyneux work well illustrates the promise that Project Prakash holds: providing medical care to children with disabilities, while at the same time advancing fundamental science." says Pawan Sinha. "Project Prakash is proving to be truly gratifying."