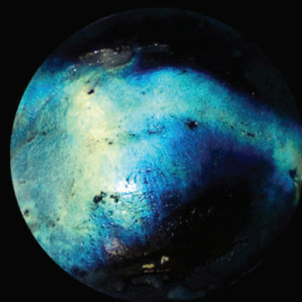
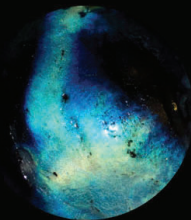


SUMMER
2012

CNBCConnect



Center for the Neural Basis of Cognition

A JOINT PROGRAM | CARNEGIE MELLON UNIVERSITY | UNIVERSITY OF PITTSBURGH

From the co-directors

CNBC – a growing family. Welcome to the second issue of CNBConnect. We hope you enjoy keeping current with the many goings-on at the CNBC. The past year has been a good one – we have grown significantly in

size, we have been successful in competing for funding, and the quality of our faculty and trainees, as well as the CNBC itself, has been acknowledged with many honors. We'd like to highlight here a few milestones.

First, we would like to welcome the seven new faculty joining our already strong cohort of early career scientists: Steve Chase (CMU), Mina Cikara (CMU), Marlene Cohen (Pitt), Aryn Gittis (CMU), Sandra Kuhlman (CMU),

Anne-Marie Oswald (Pitt), and Tim Verstynen (CMU). You will be hearing about their research over the next several issues of CNBConnect.

Second, we would like to congratulate our NIH training grant PIs for their successful renewals: the Training Program in Computational Neuroscience ("TPCN"; Rob Kass and Bard Ermentrout), the Multimodal Neuroimaging Training Program ("MNTP"; Seong-Gi Kim and Bill Eddy), and the Brain and Behavior Training Program ("B²"; Lori Holt and Julie Fiez). We look forward to a new generation of scientists trained with aid from these grants.

Third, for the first time since 2004, the CNBC was reviewed by an External Advisory Board. By all accounts, the review was a tremendous success. As Co-Directors, we are working with our two administrations and our offices of advancement to build on this outstanding review to ensure the future health and success of the CNBC. We also thank the members of the EAB for their thoughtfulness and diligence.

Finally, we are sad to announce the passing of George Cowan, a great friend of the CNBC and one of the most important post-WWII American scientists. Among George's many accomplishments: he worked on the Manhattan Project, helped form Los Alamos Labs, founded the Santa Fe Institute, and was a generous philanthropist. Only the week before his death at 92, his friends from CMU and Santa Fe held a lunch in his honor, and Mike had the pleasure of visiting him at his home in Los Alamos. The CNBC will greatly miss George's support and friendship.



Peter Strick and Michael J. Tarr

On the Cover:

PHOTOGRAPH of sheep eyes by Jena Tegler. See Marlene Behrmann article, p.3.

If you have news you would like to share please email us at: cnbc-newsletter@cnbc.cmu.edu.

Layout: Barbara Dorney, Kristen McConnell, Melissa Stupka

Editorial/Content Contribution: Cassandra Weaver

New Course Spotlight: **Marlene Behrmann** *Melding Art and Science*

Faculty who teach the required Freshman seminar in the Dietrich College of Humanities and Social Sciences at CMU are encouraged to coax students out of their comfort zone in order to explore a wide ranging set of controversial and unusual issues, preferably in an experiential context. Fortuitously this summer, as I was drawing up the syllabus for my Freshman course to be taught in Fall 2011, I met Patricia Maurides, a photographer in the College of Fine Arts. Patricia has a longstanding interest in biology and in the brain and has done some outstanding work. Together, we hatched the madcap idea of bringing together her digital photography art class and the freshmen from my seminar to build a bridge between art and science.

We dithered a little during the process of deciding what material to cover, and we contemplated the logistics of having roughly 30 students handling organic tissue, wielding scalpels and needing hazmat bags. We decided to break ground in several novel ways: we would teach the students a little neurobiology, specifically concerning the eye and the brain, and we would conduct classes in which students could dissect a sheep eyeball and brain. The photography students could participate in the dissection and/or photograph the process. We would view the photographs and hold a final exhibition to which we would also invite the public. And above all, we would stress the value of interdisciplinary research, of how the process of stretching and bridging from a home discipline brings discontinuities and novel insights.



Marlene Behrmann (left) & Patricia Maurides (right)

Students also provided written reflections throughout. The responses to the class were many and varied. Some of the art students were initially repulsed while others were exhilarated:



Science & Art in Action. Photo by Patricia Maurides

“So psychology and biology were never my strong suits in high school. We dissected a cat in 10th grade, and I don’t remember anything about the experience except being thoroughly disgusted when my classmates flung organs at each other. I am of the opinion that dissections need to be handled with a mature audience/group of participants, so I am relieved to have been surrounded by peers that were actually focused and intrigued by all that can be learned from a dissection... These dissections were definitely different than any photo shoot I’ve ever had, but the experience was well worth the gore.”

“My initial response to the dissection was overwhelming. The notion of getting direct, hands-on experience of a dissection and successfully bridging the gap between arts and sciences is why I came to Carnegie Mellon University in the first place. Both parts of my brain were working in overdrive: the creative side and the scientific side. As an aspiring surgeon, I loved the feeling of real biological tissue in my hands. The texture of the rubbery fat coating the sclera and the cold ooze of the vitreous humour inside of it ...”

At the end of the joint sessions, the freshman critiqued a paper on the art and science of long-term collaboration by Alexa Wright and Alf Linney, who conclude that “creative collaborative partnerships open up a space where individual artists and scientists can gain a new perspective on their own work and together can acquire new tools to reflect on some of the bigger issues that concern us all.”

The class is over, but its impact is intended to endure. Friendships were formed; new perspectives attained; energy and enthusiasm, along with anxiety, were generated. And, finally, as a mark of this collaboration, the joint art/freshman students hosted an exhibition of the photographs and responses. The show featured a wide range of photography from the initial eye and brain dissections to visual explorations of perception. Entitled “NEUROPHOTO”, the show was held at The Frame Gallery at CMU from January 16-22, 2012.

New Faculty Spotlight: **Wayne Wu** *Attending to Attention*

In 2009, two Northwestern pilots overshot their destination by 150 miles, oblivious to frantic signals from air-traffic controllers and their plane's instrumentation. How could this happen? Apparently, the pilots were focused on examining new flight-crew scheduling procedures on their laptops and did not notice the warnings. Clearly, focused attention can make one unaware of nearly everything else. But what is attention? Various theories of attention exist in neuroscience and psychology, but how do these relate to each other? Such questions have engaged Wayne Wu's work for the past five years. Since 2010, he has taught at CMU where he has a full-time appointment in the CNBC.

Wu's PhD is in philosophy, and a large part of his research lies at the intersection of philosophy and science. "Scientists are often puzzled by what philosophers do," Wu observes. "But a lot of philosophy is close to science. The goal of philosophy is to understand the world." Philosophers start with questions like: what is free will, consciousness, knowledge or the mind? The "what is" question extends to phenomena studied in cognitive science: what is representation, sensation, memory and attention. Wu notes, "Answering these questions requires conceptual and logical analysis and here philosophy can contribute to science."

Wu's education covered areas a far cry from where he works now. As an undergraduate at MIT, he focused on molecular biology and chemistry. "I guess I felt certain that I wanted to do science and at the time, the idea of understanding 'life' from basic physical and chemical principles was alluring," he recalls. "I got a chance to learn and work with biologists who were part of the molecular revolution in biology. It was inspiring, so I took as many science classes as I could. I certainly didn't take any philosophy!"

After receiving a BS in biology, Wu went to UC Berkeley as a graduate student in Molecular and Cell Biology where he settled in the Chemistry Department, working with Peter Schultz on using unnatural amino acids as a way to probe the structure and function of gene regulatory proteins. "The problem was that I hated bench work!" he laughs. He left graduate school with a master's degree, but without much of a plan. "Berkeley's the place to bum around while you're figuring out what to do with your life, but you want to get going. I was still interested in science at a theoretical level, so I got into philosophy of science." Wu again relocated across the country to undertake three years of study at the University of Pittsburgh in the Department of the History and Philosophy of Science before returning to Berkeley where he finished his PhD in philosophy in 2005. He then spent four years at Ohio State as assistant professor in Philosophy before moving to CMU.

"Attention was my first attempt to tie philosophy and science," Wu notes. His attempts to answer the question,

"What is attention?", stem from his effort to answer a different question: what is intentional action? Consider the opposite of intentional action, a pure reflex that maps a single input to a single output. You wouldn't want to be a creature whose behaviors are just reflexes, but what must you add to such a system to make intentional action possible? Wu reasoned that a genuine agent needs choices or options, something not available in behavior structured by a rigid one-one map of input to output. With options from multiple inputs and outputs, the agent can now respond to many different stimuli in many different ways. Freed from reflex, intentional action is possible.

Agency, Wu concluded, means having to deal with this Many-Many Problem: at any time, agents are confronted with multiple options (many inputs and many potential outputs). Critically, they can't do everything at once and this is where Wu realized attention is necessary. Agents must be selective and solve the Many-Many Problem by selecting specific inputs to inform specific outputs. For example, if you wanted to kick a ball when two balls are lying in front of you, you have to select which ball and which foot to kick it with. Without this selection, no action would happen. Wu concluded that the selection of input to act is what attention is. Indeed, attention is a necessary feature of action.

Wu's research continues to focus on attention with multiple projects in the works. This spring, he and CNBC faculty members, Marlene Behrmann (CMU, Psychology), Marlene Cohen and Carol Colby (Pitt, Neuroscience) ran a discussion group on theories of attention open to the CNBC community. The first meeting brought together nearly 40 CNBC students, post-docs and faculty, with the group now meeting on a monthly basis. He also recently co-edited an interdisciplinary volume on attention for Oxford University Press and is writing an introduction to the philosophical issues regarding attention for Routledge's *New Problems of Philosophy* series.

Wu also works on other topics: consciousness, spatial representation, perception, agency, and the positive symptoms of schizophrenia in collaboration with CNBC faculty member Ray Cho (Pitt, Psychiatry). The strength in multiple areas and levels of analysis at the CNBC and the collegiality of the faculty within the program has been a great resource for him. "My colleagues have been immensely welcoming, inviting me to their lab meetings, answering my often left-field questions."



He has also enjoyed interacting with the students in the CNBC, something he got a taste for in his course on the foundations of cognitive science. That course focused on analyzing central concepts in cognitive science. He plans to teach this course every two years. "I do think science can benefit from a return to philosophical issues and methods," he notes. "It's nice to be back in the thick of science in the CNBC, though I'm glad to be doing the philosophical side of things. You can do philosophy with a cappuccino in hand!"

Peter Strick *Elected to National Academy of Sciences*

The CNBC is pleased to report the election of its University of Pittsburgh Co-Director, Peter Strick, to the National Academy of Sciences. Among the many contributions Strick has made to our understanding of the brain, a central component has been his work on understanding the language and circuitry of the motor system and his development of novel virus tracing methods for probing that system.

"Dr. Strick is an outstanding researcher who has greatly added to our understanding of the neural circuitry of the motor system," notes Dr. Arthur Levine, Senior Vice Chancellor for the Health Sciences and Dean, School of Medicine, University of Pittsburgh. "His election to the Academy is indicative of the quality of his research and the importance of his findings." Michael Tarr, CMU Co-Director of the CNBC, added "This is a wonderful news for Peter and the entire CNBC community. We congratulate him on this well-deserved honor."

A reception was held to honor Peter at Pitt's University Club on May 15, 2012.

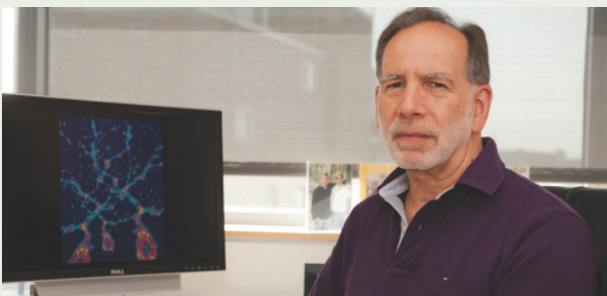


Photo by Jim Burke/CIDDE

Graduate Student Spotlight: **Luke Hyde** *Development & Intervention*

Luke Hyde's background abounds with disparate experiences that motivate his current work on adolescent antisocial and delinquent behavior in the Clinical and Developmental Psychology program at the University of Pittsburgh. During his undergraduate studies at Williams College, Hyde carried out an independent research study examining child learning from stories and spent time as a mentor to adolescent boys adjudicated to a residential facility for criminal offenses. Following graduation, Hyde worked as a teacher at a boarding school and served as Assistant Director of a summer camp where he worked with



children with special needs. This history of working with children and adolescents from all backgrounds sparked his interest in child development and molded his ambitions to include a career investigating developmental psychopathology and behavioral interventions. "It's easy to see people with depression as suffering from an illness but harder with antisocial behaviors", Hyde notes. "The more we understand these behaviors, the better chance we have of giving these kids an equal shot at a fulfilling life. I hope that my work can help us understand how biology and experience interact so as to improve prevention and treatment of behavior problems early on."

Hyde came to Pitt to join the prestigious Clinical and Developmental Psychology program where he began his work with Dr. Daniel Shaw and the Pitt Mother and Child Project (PMCP), a longitudinal study following a population of 310 at-risk boys from age 1.5 to 20. In his Master's thesis (Pitt, 2007), Hyde used data collected from the PMCP to dissect the link between multiple risk factors and development of antisocial behavior during adolescence. He found exposure to harsh parenting in early childhood, residence in impoverished neighborhoods and low empathy during early adolescence all contribute to emergence of antisocial behavior in adolescence via their effects on adolescent attitudes about violence.

Though his masters project had focused on environmental risk factors for later antisocial behavior, Hyde was interested in further understanding biological (e.g., genetic, neural) contributions to these pathways. Thus, in 2007, with the hopes of taking a more interdisciplinary approach to his research, Hyde joined the CNBC and was awarded a B² training grant which aims to help graduate students gain experience in both behavioral and brain research. The program enabled him to collaborate with Dr. Ahmad Hariri and learn valuable neurogenetic techniques that he applied to his research on psychopathology. In an effort to integrate his developmental psychopathology work with neurogenetic techniques, Hyde's doctoral thesis includes a neurogenetics study (with fMRI and a focus on serotonin genes) on PMCP participants at age 20 to examine links between serotonin genes, amygdala reactivity and antisocial behavior across different early environmental risk factors. Data collection on this project is just finishing and Hyde is excited to examine if individual variability in serotonin genes interact with harsh environments to predict differences in amygdala reactivity to emotional faces and subsequent increases in antisocial behaviors. In his future work Hyde would like to extend this imaging project to at-risk children before the emergence of antisocial behavior. He would then like to use his findings to aid in the development of personalized interventions for children at risk for antisocial behavior.

While Hyde's work keeps him busy, he still finds time to be an active member of the CNBC. Hyde has presented his work at a past CNBC retreat and enjoys attending Brain Bags, a weekly forum where CNBC graduate students gather to present and discuss ongoing research. "Being involved in the community has exposed me to the very wide range of research and disciplines and has helped me see that we need research at every level of analysis." In the Fall of 2012, Hyde will continue this multilevel approach when he joins the faculty of the psychology department at the University of Michigan as part of a "cluster hire" across multiple departments with a focus on Genes-Environment-Behavior. "Clearly having a concentration in Cognitive Neuroscience from the CNBC made me attractive for this position," he notes. "I'll be an assistant professor in the Clinical and Developmental areas, but hope to continue involvement with neuroscience students as well."

Research Spotlight: **Julie Fiez** *Mapping Word Processing in the Brain*

One of the challenges in neuropsychology, the study of psychological function in brain-damaged individuals, is to identify patients whose participation can help answer questions about psychological processes. While patients are often interested in participating in studies, identifying the relevant patients and connecting them to researchers has grown more difficult given increasing privacy protections. In response, CNBC faculty member Julie Fiez (Pitt, Psychology), along with CNBC faculty Marlene Behrmann (CMU, Psychology), began the Western Pennsylvania Patient Registry (WPPR) in 2008 in an effort to connect stroke patients with researchers. With seed funding from the

CNBC and the Kenneth P. Dietrich School of Arts and Sciences at Pitt, the registry's database has to date enrolled over 1000 patients. Using a database that allows searching for patients by lesion site descriptors and demographic information, researchers can quickly identify potential subjects to recruit into their studies.

Fiez's own work spans understanding learning and language processing. Some recent work has focused

Researchers interested in recruiting subjects from WPPR can contact Denise Balason at dbalason@pitt.edu or 412.624.0178.

on the function and pattern of activity of the Visual Word Form Area (VWFA). Researchers have long noted differences in lateralization of VWFA activity in speakers of languages involving different word forms. For example, readers of alphabetic languages such as English or Korean, where the basic units of the written script exhibit a consistent mapping to phonemes, show robust left lateralization of VWFA activity during word reading in their native language. In contrast, readers of Chinese, where the written forms convey information about larger sound units (such as words) and word meaning, show bilateral activation of VWFA when reading Chinese. This, along with behavioral data, suggests that different computations are carried out by the left and right VWFA.

What happens when native speakers of English or Chinese acquire the other language? For native English speakers who acquire Chinese, imaging work shows bilateral activation of VWFA during reading of Chinese as one might expect given earlier data. Interestingly, in work in collaboration with CNBC faculty member Charles Perfetti (Pitt, Psychology), Fiez and co-workers discovered that native Chinese speakers



who acquire English also show bilateral activation of VWFA during reading of English, something not seen in native English speakers or in native Korean speakers who acquire English as a second language. One explanation of this difference is that the acquisition of a second language might sometimes be built upon the computational machinery used in one's native language, a process that Fiez and Perfetti dub *assimilation*.

The assimilation of English reading to the bilateral machinery used in processing Chinese Words appears to be functionally important. Some evidence for this comes from the effects of word inversion, in which a printed word is rotated 180 degrees. Inversion of faces is known to disrupt right-lateralized visual processing for face recognition. If right lateralized VWFA activity is important in processing English in Chinese-English bilinguals, then one possibility is that inversion of printed English words will effect Chinese-English bilinguals more than Korean-English bilinguals whose word processing is left lateralized. This is what is observed.

But what is the function of the left VWFA that is active in all language reading? The issue remains contested. One possibility is that the left VWFA is involved in representing perceptual features of orthographic symbols. Alternatively, it might be involved in higher-ordered mappings, say of orthographic forms to phonemes. To test this, Fiez and her graduate student Michelle Moore have recently taught native English speakers to use two artificial writing systems that greatly differ in perceptual characteristics but have a consistent mapping to phonemes. In one system, termed "FaceFont," faces are mapped to phonemes while another system, termed "KoreanFont," utilizes a new mapping of Korean orthography to phonemes. Subjects were able to learn these associations and read words in either writing system.

One crucial finding of the study was that the activation of the left VWFA detected by functional magnetic resonance imaging (fMRI) during word reading in either artificial writing system correlated with the subjects' acquisition of that

artificial language, suggesting that the VWFA plays a role in the process. To test whether the VWFA is essential for the acquisition of FaceFont, the research team turned to WPPR to identify a participant with damage to the VWFA. As expected, this participant had lost the ability to read fluently, even though all other aspects of language were intact. Consistent with this, the participant was unable to acquire FaceFont by learning face-phoneme associations. Surprisingly, she was able to learn face-syllable associations. The team has yet to determine what brain areas support this residual function, but speculate that the right VWFA is playing a role.

The finding is suggestive of possible therapeutic avenues. For example, if Fiez's current hypothesis about VWFA function is confirmed, it may then be possible to bypass damage to left VWFA by pushing patients to draw on right VWFA function by learning a language that maps to syllables rather than phonemes. In the future, Fiez plans to explore this and other open questions, such as the possibility that individuals with developmental and acquired disorders of language may be able to read syllable-based writing systems more fluently than an alphabetic writing systems.



Examples of word-level presentation in "Face" and "Korean" font from upper left moving clockwise: "sue," "test," "jar," and "gate."

Honors & Awards

Faculty

Brent Doiron has been named recipient of the 2012 Chancellor's Distinguished Research Award.

Marlene Cohen received a Klingenstein Fellowship in the Neurosciences and a New Investigator Grant from the Whitehall Foundation.

Peter Gianaros was elected to the Academy of Behavioral Medicine Research.

Brian MacWhinney was the first recipient of the Triennial Rogre Brown Award of the International Association for the Study of Child Language.

Michael Pogue-Geile was elected president of the Behavior Genetics Association for 2011-2012 and president of the Society for Research in Psychopathology for 2010-2011. He was also appointed to the editorial board of the Journal of Abnormal Psychology in 2012.

Joel Schuman received the Carnegie Science Life Sciences Award for pioneering the development of optical coherence tomography (OCT), a powerful tool that aids in the early detection of eye disease, specifically glaucoma; 2012 National Glaucoma Research Award - Spectral Domain OCT Doppler Assesses Aqueous Outflow; America's Top Doctor's 2012; Best Doctors in America 2012.

Richard Randall's lab has been awarded a UPMC Brain Mapping Center MEG Research Seed Fund (\$10,000).

Matthew Smith received a RPB (Research to Prevent Blindness) Career Development Award in January 2012.

Michael Tarr will present the keynote lecture of the 20th Annual Meeting of OPAM (Object Perception, Attention, and Memory), November 2012, Minneapolis, MN.

Kittie Verdolini Abbot was named the 2011 G. Paul Moore Lecturer for the Voice Foundation's annual symposium. This is an invited lecture that is essentially a "life-time career recognition" event for a "senior person in the field who has made substantial contributions." The Voice Foundation is generally considered the premier organization in voice science and clinical voice worldwide.

Ph.D.s

Wenzhu Bi, 4/9/12, Pitt Biostatistics (Weissfeld)

Dennis Bourbeau, 6/22/11, Pitt Bioengineering (Weber)

Samuel Clanton, 7/21/11, CMU Robotics (Schwartz)

Karin Cox, 11/30/11, Pitt Psychology (Fiez)

Tamar Degani, 6/14/11, Pitt Psychology (Tokowicz)

Sonya Giridhar, 4/9/2012, Pitt CNUP (Urban)

Anoopum Gupta, 9/27/11, CMU Robotics (Touretzky)

Husam Katnani, 5/10/12, Pitt Bioengineering (Gandhi)

Witold Lipski, 11/28/11, Pitt CNUP (Grace)

Sagi Perel, 4/30/12, Pitt Bioengineering (Schwartz)

Andrew Samuelsson, 7/21/11, Pitt CNUP (Xu)

Nelson Totah, 12/14/11, Pitt CNUP (Moghaddam)

Jing Wen, 4/3/12, CMU Biological Sciences (Barth)

Valentinos Zachariou, 9/28/11, CMU Psychology (Behrmann)

Alumni

Luke Hyde (Shaw & Hariri Labs) accepted an assistant professor position in the Psychology Department at the University of Michigan.

Ryan Kelly ('11 Lee Lab) accepted a position as a Software Engineer for Google in New York City.

Elli Kanal ('09 Sun Lab) accepted a position as a Quantitative Analyst at PNC Bank, Pittsburgh, PA

PostDocs

Amanda Dettmer (Cameron) a third year postdoc was recently awarded an individual NRSA (F32) by NINDS for one year as of Sept. 1 for her project entitled, "The Efficacy of Neurotrophic Factor CDFN in Treating Parkinsonian Symptoms."

Sophie Lebrecht (Tarr) participated in the NSF I-Corps (Innovation Corps) program as part of her start-up company, Neon Labs.

2012 Retreat "Most Outstanding Poster Awards"

David Whitney (left), **Sonya Giridhar** (right), with Peter Strick (center).

