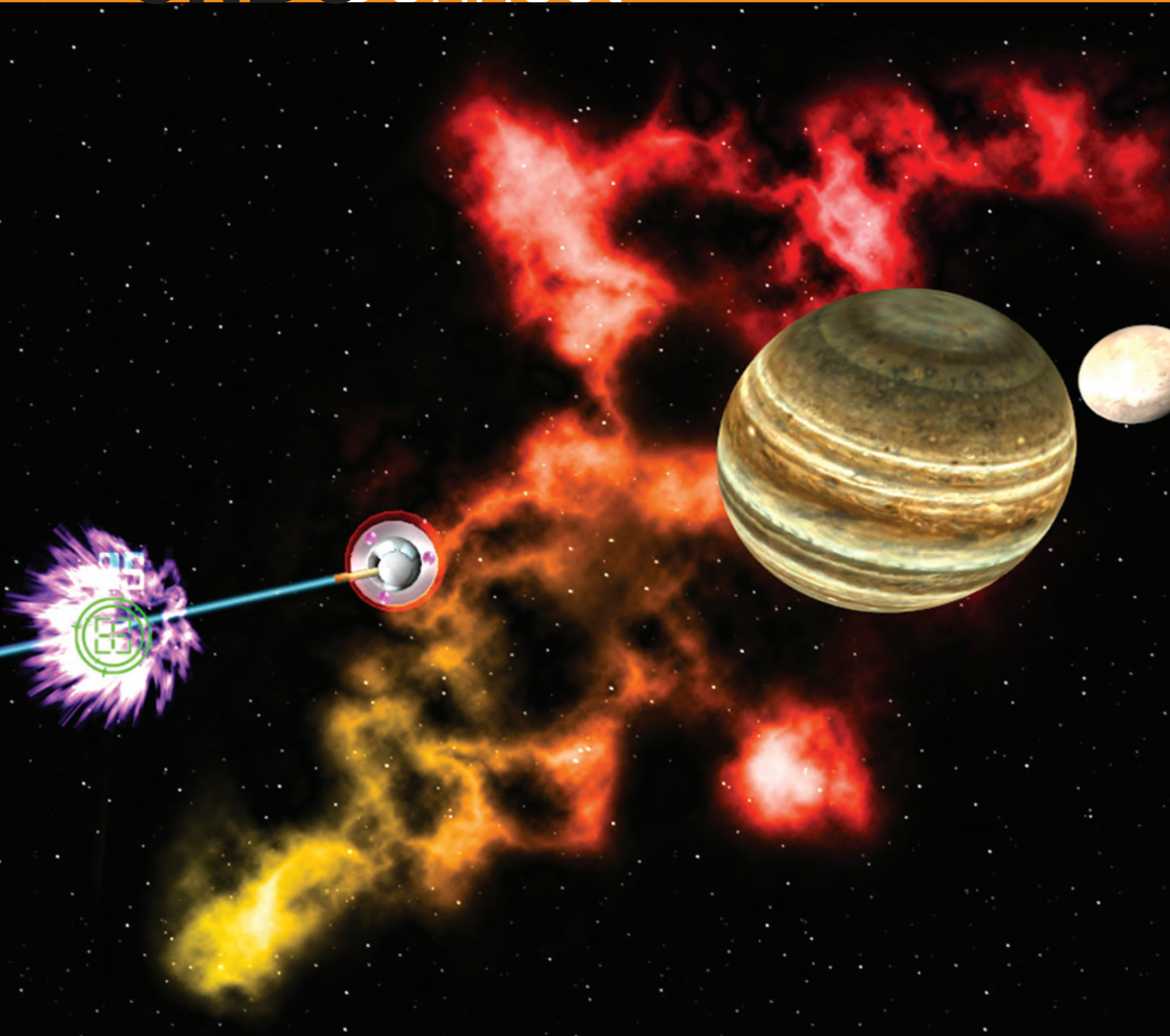


# CNBCConnect



# Center for the Neural Basis of Cognition

A JOINT PROGRAM | CARNEGIE MELLON UNIVERSITY | UNIVERSITY OF PITTSBURGH

# From the co-directors

**CNBC – sustained excellence.** Welcome to the third issue of the CNBConnect. The last several years have been productive ones, and we are happy to report on the successes of members of our community and its continued growth.



*Peter Strick and Michael J. Tarr*

In the last issue, we highlighted the recruitment of several new faculty members, and in this issue, we get to meet many of them in more detail: Steve Chase (CMU), Mina Cikara (CMU), Kasey Griffin Creswell (CMU), Aryn Gittis (CMU), Sandra Kuhlman (CMU), Anne-Marie Oswald (Pitt), and Tim Verstynen (CMU). We hope you enjoy reading about their research interests and background.

We are also pleased to report that we will continue to grow in the coming year with several senior-level searches, as well as a search for a junior faculty member to fill the new endowed Zdrojkowski Career Development Chair in the area of human developmental neuroscience.

Our faculty continue to gain national and international recognition for their research accomplishments, with Alison Barth receiving a McKnight award, Marlene Cohen winning the Eppendorf Prize and Aryn Gittis as a finalist for the same award, and Lori Holt winning the Troland Award from the National Academy of Sciences. An article in this issue discusses their achievements.

With the support of the Carnegie Corporation of New York, we awarded the first Andrew Carnegie Prize in Mind and Brain Sciences to Leslie Ungerleider, Chief of the Laboratory of Brain and Cognition at the National Institutes of Health. The award ceremony provided an opportunity for members of the CNBC to catch up with Leslie's groundbreaking work and an excuse to celebrate the achievements of a longtime friend of the CNBC.

The coming year is a particularly exciting one in that the CNBC will be celebrating its 20th Anniversary in 2014. Please mark October 17-18, 2014 on your calendars for a special gala celebration and symposium in Pittsburgh to celebrate this milestone. More details will be announced throughout the course of this coming year. We look forward to hearing from you and, hopefully, seeing you in October 2014. For now please join us in learning about our ever growing and truly wonderful community of scholars.

## On the Cover:

Cover art from software developed by Neurltone. Image courtesy of Ran Liu and Lori Holt.

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

Layout: Kristen McConnell, Barbara Dorney

## Collaboration Spotlight: **Lori Holt**

### *Alien Sounds*

The CNBC aims to facilitate collaborations across disciplines to promote understanding the neural basis of cognition. A recent collaboration between researchers in the CNBC and students at the Entertainment Technology Center (ETC) at CMU nicely highlights how unexpected connections can open up new avenues for research. The ETC offers a Master's in Entertainment Technology and is jointly run by the College of Fine Arts and the School of Computer Science.

Lori Holt (CMU Psychology) and members of her laboratory have been studying implicit learning of auditory information with a novel use of a space-alien video game involving capturing or destroying aliens that emit sounds from different auditory categories. Holt notes, "We developed the videogame to address whether complex auditory categories like phonetic categories could be learned incidentally in a rich multimodal environment." In recent work with members of her lab (CNBC and CMU psychology students, Sung-joo Lim, Ran Liu and Matt Lehet), Holt discovered that subjects could learn complex nonspeech auditory categories while playing the game. This learning involves changes in early auditory processing of non-speech sounds and seems to recruit regions of the posterior superior temporal sulcus, a region that is thought to be part of the speech network (Liu and Holt, 2011). In fact, when the aliens in the game emitted English /r/ and /l/ sounds, native Japanese speakers who often have difficulty distinguishing between these sounds can improve categorization in 2.5 hours of gaming at performance levels that would take 3-4 weeks to acquire in overt categorization training (Lim and Holt, 2011).

One of the technical challenges, however, has been to have game technology keep up with the increasingly complicated research questions that Holt's group addresses. Enter the students from the ETC. As part of the ETC's Master's Program, students participate in interdisciplinary projects where teams develop products for clients. Holt's laboratory teamed up with a group of master's students comprising Neurltone, a rubrik the team adopted when contracted by Holt to produce a new videogame. Neurltone consists of Garrett Kimball, Lei Feng, Jingyi Feng, Evan Li, Erica Hampson, and Rodrigo Cano.

Over the course of the semester, the two teams worked closely together. Neurltone hashed out ideas amongst themselves, developed and tested them, then brought their ideas or products to Holt's team to tweak and alter. The goal was to design a new game that allowed Holt's group to have a greater ability to control different parameters of the game, depending on the research questions, and to allow ease of collecting data. At the same time, Neurltone focused on making a game that was engaging and fun. This included maintaining *juiciness*, a technical concept in the game design world that refers to the payoff that players experience, as when achieving a goal leads to a high award as well as pleasing stimulation such as an



*Neurltone Team: Xiuyuan (Evan) Li, Lei Feng, Erica Hampson, Rodrigo Cano, Garrett Kimball, Jingyi Feng*

explosion. Indeed, Holt notes that for a cognitive neuroscientist, juiciness suggests a way that the videogame might facilitate learning by tapping into reward systems in the brain: "Our videogame may be effective at promoting efficient learning because it includes goal-directed action for which there are positive or negative outcomes contingent on one's behavior."

For the members of Neurltone, the interaction both allowed them to take part in all aspects of product design as well as learn a bit about the brain. "It's amazing to see how effectively games can be used to train the brain," notes Garrett Kimball, the team's producer. "It's been very interesting to see how our project has been directly influencing the learning of others in a concrete, measureable way." Of course, creating a game that served high-level research in cognitive neuroscience presented some challenges. Erica Hampson, who created the sounds and music for the game, observes, "Balance was key throughout this whole process. We had to balance the gameplay, the sounds, and the art so that it made for an interesting gaming experience while not hindering its effectiveness as a research tool. So, to keep the game engaging, we added changing backdrops and various music tracks to give each level a different feel." The results are quite spectacular (see cover and [www.etc.cmu.edu/projects/neurltone/](http://www.etc.cmu.edu/projects/neurltone/)).

An exciting possibility is future interactions between the CNBC and ETC. **Interested CNBC faculty members can submit a proposal for External Sponsorship to the ETC by contacting the head of the ETC, Drew Davidson at: [drew@andrew.cmu.edu](mailto:drew@andrew.cmu.edu). Proposals for the Spring semester must be submitted by the end of October.**

*Liu, R. & Holt, L.L. (2011). Changes in mismatch negativity reflecting the acquisition of complex, non-speech auditory categories. Journal of Cognitive Neuroscience, 23, 683-698. PMC2945418.*

*Lim, S.-J. & Holt, L.L. (2011). Learning foreign sounds in an alien world: Videogame training improves non-native speech categorization. Cognitive Science, 35, 1390-1405. PMC3166392.*

## New Faculty Hires

### *An Exciting Future*



Steve Chase

In the past two years, the CNBC has welcomed a large number of junior faculty who use a variety of different methodologies including electrophysiology, functional imaging, and computational analysis to address a host of different questions in sensory, motor and affective systems. They are: Steve Chase (CMU Biomedical Engineering), Mina Cikara (CMU Social and Decision Sciences), Kasey Griffin Creswell (CMU Psychology), Aryn Gittis (CMU Biology), Sandy Kuhlman (CMU Biology), Anne-Marie Oswald (Pitt Neuroscience), and Tim Verstynen (CMU Psychology).

**Steve Chase** joined the CNBC and Biomedical Engineering at CMU in 2011, having recently completed post-doctoral work with CNBC professors Rob Kass (CMU Statistics) and Andy Schwartz (Pitt Neurobiology) where he used brain-computer interfaces to study adaptation and plasticity in primary motor cortex. Chase's current research focuses on the representation of information within neural networks: how trains of action potentials encode perceptions and intentions, how these representations change across brain areas and how they are used in computations, especially in motor control. In particular, he is investigating how sensory feedback impacts the neural representation of motor intent at multiple levels.

To do this, Chase continues to use brain-computer interfaces. These devices allow him to tap directly into the output of a network of neurons and use that recorded activity to drive a device such as a computer cursor. By creating a defined link between neural activity and behavior, brain-computer interfaces provide a window for probing brain processes that would otherwise remain covert, like learning, adaptation, and the dynamic evolution of the intent signal. Chase's hope is that understanding these phenomena will not only inform us about the fundamental limits of motor control processes but also aid the development of new neural prosthetic devices.

Chase grew up in rural New Hampshire, "raised as a goat herder" as he puts it. He received his BS in Applied Physics



Anne-Marie Oswald

from Caltech and his MS in Electrical Engineering from UC Berkeley where he was active with the Berkeley club hockey team. He then completed his PhD in Biomedical Engineering at Johns Hopkins. Having been immersed in several high-powered academic environments, Chase notes that "the Pittsburgh area probably has a higher density of neuroscientists than anywhere else in the world. For the research I do, this is absolutely the best place to be." In his spare time, Chase puts his motor control in action herding hockey pucks.

**Anne-Marie Oswald** joins the Department of Neuroscience at the University of Pittsburgh. As a graduate student at the University of Ottawa, Canada, Oswald studied the representation of behaviorally relevant prey and communication stimuli by the electrosensory system of electric fish. This work introduced her to multidisciplinary aspects of neuroscience, combining neurobiology, computation and modeling. Oswald then completed a post-doc at NYU studying cortical circuitry and most recently a post-doc with CNBC faculty member Nathan Urban (CMU Biology) where she began working on the olfactory system. Using the olfactory system, Oswald investigates how sensory information is encoded in the brain. "I find odor processing especially fascinating because of the interplay between the coding of olfactory information and behavioral and emotional states," she notes. "It is well known that odors can trigger strong emotional memories. How does this happen? What circuits underlie the formation of these odor percepts?"

To address these questions, Oswald's lab focuses on the circuit mechanisms of olfactory processing in the piriform cortex, investigating the connectivity and synaptic properties of excitatory and inhibitory circuitry therein. A central goal is to identify functional circuit motifs that underlie olfactory processing during behaviors such as active sniffing or during olfactory tasks. To do this, Oswald uses optogenetics, patch clamp, calcium imaging, computation and modeling.



Tim Verstynen

She also hopes to extend these experiments to incorporate behavior and translational studies.

Oswald has honed this multidisciplinary approach throughout her career, and having been part of the CNBC on both the CMU and Pitt side, she is a strong supporter of its interdisciplinary focus. Part of this involves a strong collaboration with Brent Doiron (Pitt Mathematics and CNBC) that has resulted in five joint publications and continues to this day. Oswald is also involved in building links between members of the CNBC and has organized with Tim Verstynen the CNBC junior faculty happy hour to promote communication and collaboration among new members of the CNBC and where an occasional beer is consumed.

**Tim Verstynen** got hooked on psychological research early on. “In college I took my first Brain & Behavior course and got addicted to research. I haven’t looked back since,” he notes. After completing his PhD at UC Berkeley in 2006, Verstynen completed post-docs at UCSF and the University of Pittsburgh working on theoretical neurobiology and diffusion weighted imaging analysis. He began as an assistant professor in the CMU Psychology Department and the CNBC in 2012.

Verstynen’s research centers on mapping the neural systems involved in planning, executing and (sometimes) inhibiting actions. These abilities rely on the coordinated activity of broad networks that span nearly the entire cortex. At a general level, Verstynen’s work addresses how the physical integrity of these networks gives rise to our actions. More specifically, he focuses on how the architecture of the sensorimotor pathways gives clues about their function and how changes in the integrity of the anatomical “wires” that connect these brain areas can influence behavior. To tackle these issues, Verstynen combines behavioral, computational modeling and MRI-based neuroimaging tools.

Verstynen has found much to draw from in the open and highly collaborative environment of the CNBC. At CMU, this



Aryn Gittis

includes ongoing collaborations with CNBC colleagues in Psychology (Mike Tarr & David Creswell), Social and Decision Sciences (Mina Cikara) as well as faculty in Statistics, Machine Learning, and the School of Business that have yielded joint publications and grants, including a recent Big Data grant through the National Science Foundation for developing novel analytical tools for analyzing structural brain networks. Verstynen has also collaborated with CNBC faculty at the University of Pittsburgh, including Kirk Erickson and Pete Gianaros (Department of Psychology). He looks forward to many more interactions, research and social: “In my nearly 15 years of experience doing cognitive neuroscience research I have never come across such a unique collection of pooled resources like what we have at the CNBC.”

Like Verstynen and Chase, **Aryn Gittis** also works on the motor system, using mice as a model organism, with focus on the basal ganglia. Dysfunction in the basal ganglia is involved in movement disorders such as Parkinson’s disease, Huntington’s disease, Tourette syndrome, and dystonia. In healthy individuals, the basal ganglia applies a brake on movement, suppressing unwanted movements and allowing desired movements to proceed through the brain’s motor circuits and down to the muscles. In Parkinson’s disease, the brake function of the basal ganglia becomes too strong and even desired movements are prevented from reaching the muscles. Gittis wants to understand how this brake function arises through the activity of neurons and which neurons are particularly susceptible to dysfunction in Parkinson’s disease and other movement disorders. Her lab aims to uncover neural circuit organization and function in the basal ganglia as it relates to movement.

Gittis uses mice as a model organism. Like humans, mice require dopamine for normal function of the basal ganglia and when dopamine neurons are damaged by injecting a toxin into the brain, mice develop motor deficits similar to those of human patients with Parkinson’s disease. To identify specific neural circuits within the basal ganglia



Sandy Kuhlman

whose function is changed by dopamine depletion, Gittis uses transgenic mouse lines that label unique subsets of neurons. With these tools, Gittis can identify connectivity maps on the microcircuit level in healthy mice and in dopamine-depleted mice.

Gittis completed her PhD at UCSD and then a post-doc at the Gladstone Institute, UCSF. She began in CMU Biology in 2012 and was a recent runner-up in the prestigious Eppendorf and Science Prize in Neurobiology (see CNBC awards round-up). Her essay, "Striatal Interneurons: Causes or Cures for Movement Disorders?," was published in *Science* and discusses her research on the abnormal activity of neurons in the striatum of patients with movement disorders.

**Sandy Kuhlman** joins the Biology Department at CMU and uses mouse models to understand plasticity and learning. A central question for her is how animals learn to behave appropriately in their local environment. We are born with an innate set of tools to help us navigate through the environment, but precisely how the tools are employed and refined depends on experience. A critical challenge in neuroscience is to understand how the division of labor among different cell types enables the neural computations required for the development of proper sensory processing and navigation during postnatal maturation and the transition from young, sheltered living to full adult independence. By splicing the DNA that codes for fluorescent proteins found in jellyfish and corals into the genome of mice, and using state-of-the-art multiphoton laser-scanning microscopy, the Kuhlman lab visualizes and tracks the circuit changes that occur in the brains of awake behaving animals as they learn new skills.

Kuhlman completed her PhD at the University of Kentucky, focusing on circadian rhythms in mammals. She was a post-doc at Cold Spring Harbor working on inhibition and synaptic plasticity, and then most recently, a post-doc at UCLA working on sensory experience and the construction



Mina Cikara

of neural circuits during critical periods of development. As a child growing up in New England, Kuhlman was fascinated by and also slightly jealous of creatures that had unique sensory capabilities such as electrical sensation. The childhood question "Why can't I sense electricity like those fish?" has led to a research program focused on defining the neural correlates of sensorimotor learning. Kuhlman's work is multidisciplinary, and she looks forward to collaborating with biologists at CMU and systems neuroscientists in the CNBC to harness the molecular tools being developed at CMU's Molecular Biosensors and Imaging Center (MBIC).

**Mina Cikara** is an assistant professor in Social and Decision Sciences at CMU. She received her PhD in Social Psychology at Princeton University examining how social group membership modulates empathic response and the processing of communication. Cikara then did a post-doc in the Department of Brain and Cognitive Sciences at MIT. Her research examined conditions under which basic social, cognitive and affective processes "go awry" in typical individuals. More specifically, she uses social psychological and cognitive neuroscience approaches to study how misunderstanding, failures of empathy, and pleasure at others' misfortunes (*Schadenfreude*) unfold in the mind and brain. She is also interested in the behavioral consequences of these processes: discrimination, intergroup conflict, and harm.

Cikara's ongoing research continues to explore these and related questions. A wealth of research has examined the neural basis of social categorization along boundaries marked by visual cues to targets' group membership (i.e., race, sex, age). Less well understood is how the concepts of "us" and "them" are represented in the mind and brain more generally and how these concepts bear on important social processes including empathy and effective communication. Cikara is interested in whether changing how these concepts are represented can reduce intergroup misunderstanding and *Schadenfreude*, as well as downstream negative behavioral consequences.



Kasey Griffin Creswell

On joining academic life in Pittsburgh, Kasey notes: "I was fortunate to "grow up" in a very supportive and interdisciplinary graduate school program, but I recognize that not all programs comprise these qualities. The CNBC has these qualities in spades. I feel unbelievably lucky to have such welcoming and generous colleagues."

**Kasey Griffin Creswell** joined CMU Psychology having recently finished a post-doc in psychiatry at the University of Pittsburgh School of Medicine. Creswell completed her PhD in Clinical and Biological/Health Psychology at the University of Pittsburgh. She is broadly interested in understanding the social, emotional, and genetic aspects of addictive behaviors, and her research focuses on uncovering basic affective mechanisms of cigarette craving and alcohol use, with emphasis on the importance of social mechanisms in the etiology of alcohol use disorders. In addition, she is interested in the role of gene by environment interactions in predicting alcohol use and misuse.

To address these issues, Creswell uses experimental methodologies, including in vivo smoking cue exposure paradigms and alcohol administration protocols, which allow precise observations of social and emotional processing under conditions modeling real-world contexts that challenge self-regulation (e.g., while participants are intoxicated or experiencing strong cravings). Ultimately, the goal of her research is to specify the mechanisms by which individuals fail to self-regulate and to identify individuals at risk to develop addiction. This information can inform the prevention and treatment of addictive disorders and offers insights into fundamental aspects of human emotion and social functioning.

Together, these recent additions to the CNBC exemplify both a diverse set of interests that deploy different and multifaceted approaches to understanding the neural basis of cognition, perception, action and affect. They attest to the energetic research that continues to be pursued by the members of the CNBC.

## Graduate Student Spotlight:

### Marvin Leathers

#### *Value, Attention and Brain*

After growing up in rural Alabama, Marvin Leathers took a more indirect path to doing neuroscience at the CNBC and the CNUP (Center for Neuroscience, University of Pittsburgh). As an undergraduate at Samford University, a liberal arts school in Birmingham Alabama, Leathers studied classics and biochemistry. Being caught up in thinking about ethics, logic and doing research on hormonal pollutants in fish, Leathers found his way to thinking about values and rational choice. While taking a gap year after graduation, Leathers worked as a lab tech by day and read about neuroscience at night. "I wanted an



answer to the question: How do our brains create our values to guide the choices that become our lives?" While scouring the web for information relevant to the question, Leathers found papers by CNBC faculty member Carl Olson (CMU, CNBC) which further opened up new possibilities for thinking about these topics in the context of the brain. Inspired, Leathers applied to the CNUP where his application stood out in focusing on the philosopher Plato in his personal statement. After hashing out experiments over lunch with Olson during his campus visit, Leathers made up his mind to join the CNBC, and he is currently a graduate student with Olson.

Leather's dissertation work focuses on the fact that we all make value-based decisions, say when voting or picking dishes from a menu. Our choices are based on our subjective values, but how does the brain represent value? One popular account holds that the brain assigns subjective values to action-plans, and choice is a result of deciding between these plans. This action-based model finds support in work on the lateral intraparietal area (LIP) in awake behaving monkeys. Researchers have observed that LIP neurons that represent different actions (e.g. saccades) show increased activity proportional with the reward that the animal expects on completing those actions. Such LIP activity

looks to be a plausible neural correlate of subjective value in action-based decision making, and the action-based model has become entrenched in current neuroeconomics.

Leathers and Olson noted an alternative explanation of the observed LIP activity: it reflects attention not value. After all, high valued rewards also attract more attention than lower valued rewards. There is then an open question about the LIP signal: does it code for value or for salience (attention)? To answer this, Leathers conducted an elegant experiment where the animals were exposed to pictures that were associated with large or small rewards and large or small penalties. Pictures associated with large penalties provide a particularly important stimulus. If LIP activity reflects value, then LIP activity should be low for high penalties since they are presumably of low value. However, if LIP activity reflects salience, then LIP activity should be high for high penalties since this is a salient consequence. Leathers observed LIP activity to be high both for high penalty and high reward, a result inconsistent with LIP as coding value as opposed to salience. Leathers and Olson concluded that LIP activity tracks attention not value. The result, recently published in *Science*, undercuts one central piece of evidence for the action-based model.

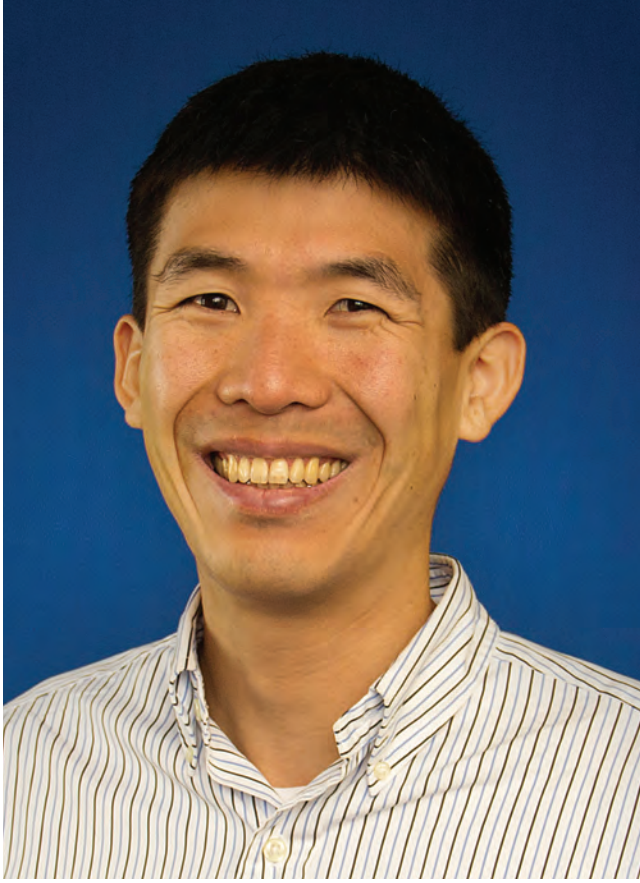
At the CNBC, Leathers has taken advantage both of the broad expertise and intellectual engagement of the community. “A fast way that a CNBC student can grow intellectually is to initiate a journal club,” he notes. “When I wanted to learn about LIP, I rotated with Carol Colby, and we formed the CNBC LIP History Club to analyze classic LIP papers. After joining the Olson lab, I wanted to learn about the neural basis of decision-making, so we formed a CNBC journal club to dissect that literature.” Currently, Leathers is continuing experiments with Olson extending their work on decision-making. He is also looking forward to the next stage in his career but sees leaving the CNBC as bittersweet: “People with both critical and creative intelligence are rare, but I’ve found many to work with among CNBC members.”

As an undergraduate in Electrical Engineering & Computer Sciences (EECS) at UC Berkeley, Byron Yu was a student in search of a research program. He had a strong interest in applying the knowledge he acquired in EECS to biology. The problem was how to bridge the gap between the two fields. Things changed when he entered graduate school in Electrical Engineering at Stanford University and began working with Prof. Krishna Shenoy, a faculty member in Electrical Engineering who also runs a non-human primate lab. Yu trained non-human primates to reach for visual targets and recorded from many neurons simultaneously in the motor cortex using multi-electrode arrays. In parallel, he applied his signal processing knowledge to develop decoding algorithms for brain-computer interfaces (BCI). This synergy between engineering and neurobiology clicked: “I was so captivated by the research that I would routinely wake up before my alarm clock rang because I couldn’t wait to get into work. It was then that I knew I had found what I wanted to build my career on.” He went on to complete his thesis on brain-computer interfaces and basic scientific studies of motor control.

After graduating from Stanford, Yu went on to do a joint post-doc with Prof. Maneesh Sahani at the Gatsby Computational Neuroscience Unit (University College London) and the Shenoy group at Stanford, spending time at each of the two locations. This collaboration involved developing machine learning methods based at the Gatsby Unit for understanding the multi-electrode recordings in motor cortex carried out at Stanford. During this time, Yu realized how much potential there was in bringing together machine learning and experimental neuroscience and, at the same time, how far apart the two fields were. This was the challenge that drove Yu to become a faculty member at CMU in 2010 in the departments of Electrical & Computer Engineering and Biomedical Engineering. He also has appointments in the CNBC, Machine Learning Department, and Robotics Institute.

A central question for Yu concerns how large populations of neurons process information, from encoding sensory stimuli to guiding motor actions. “My group focuses on developing novel statistical machine learning methods





tailored for large-scale neural recordings, and applies these methods in different experimental settings to understand how neurons work together. We are a computational group, and we collaborate very closely with experimentalists in Pittsburgh and elsewhere.” Among the local collaborators are CNBC faculty members Aaron Batista (Pitt Bioengineering), Steven Chase (CMU Biomedical Engineering/CNBC), Marlene Cohen (Pitt Neuroscience) and Matthew Smith (Pitt Ophthalmology).

One of the challenges to understanding the brain is that many of its most interesting computations are never repeated, especially those supporting tasks such as decision making, attentional switching and motor control. For example, let’s say that you are approaching a yellow light in your car. The “decision path” that your brain takes to decide whether to stop or speed forward is likely to be different each time you approach a yellow light. For example, you might decide simply to stop, you might change your mind, or you might vacillate between the two choices. To understand how the brain carries out computations like this, we need to study neural activity on a moment-by-moment basis. “With a single neuron, this is difficult because a spike train is ‘noisy’,” Yu notes. “To beat down the noise, people often average neural activity across experimental trials or across a large time window, but this effectively blurs out the effects they seek to study. With the advent of multi-electrode recordings, we can now record from tens to hundreds of neurons simultaneously, and this opens the door to the possibility of characterizing neural processes on a moment-by-moment basis. One of the core interests

of my group is to develop statistical methods that leverage the simultaneity of the neural recordings to track the time-evolution of the underlying neural process.”

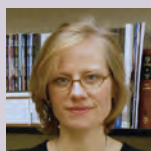
In the area of BCI, Yu seeks to understand what the motor cortex (M1) is doing on moment-by-moment basis during closed-loop BCI control. Together with Batista and Chase, Yu is asking fundamental questions about how a subject learns to control a BCI and what strategies a subject uses during proficient BCI control. The investigators are studying these questions in the context of a non-human primate controlling a computer cursor using neural activity recorded in M1. In one project Yu, Chase, and PhD student Matthew Golub are using BCI to probe the use of internal forward models by the motor system. A BCI can be viewed as a simplified motor control system which allows one to ask questions that are currently difficult to access in the skeletomotor system. Yu, Chase and Golub developed a machine learning algorithm that can extract the subject’s forward model and the subject’s moment-by-moment internal estimate of cursor position from neural population activity. This allowed them to explain what outwardly looked like irrational cursor movements as, in fact, rational movements in light of the subject’s forward model.

In another project, Yu is collaborating with Smith and PhD student Benjamin Cowley to understand how the primary visual cortex (V1) encodes different classes of visual stimuli, ranging from drifting gratings to natural movies. A key component in this study is to understand how the time-evolution of the neural population activity differs across stimuli, as well as across repeated presentations of the same stimulus. This study is enabled by statistical methods that can characterize the V1 population activity on a moment-by-moment basis.

Yu happily points out that: “There are few, if any, places in the world that have as much critical mass in areas related to my group’s research, including neuroscience, engineering, computer science, and statistics. Combine that with everybody’s physical proximity and collaborative mindset, Pittsburgh is an ideal place for this type of research.” In his free time, Yu enjoys hitting his topspin backhand, kicking balls into goals, and being creative in his kitchen.

## Recent Awards **Alison Barth, Marlene Cohen, Lori Holt**

Members of the CNBC faculty continue to receive recognition via awards and honors (see last issue on Co-director Peter Strick's election to the National Academy). Here we highlight recent prestigious national awards to CNBC faculty.



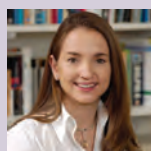
Alison Barth (CMU Biology) has received a 2013 Memory and Cognitive Disorders Award from the McKnight Endowment Fund for Neuroscience to study the cell-specific capture of experience dependent plasticity in the neocortex. As stipulated by the McKnight Foundation: "These awards support innovative efforts to solve the problems of neurological and psychiatric diseases, especially those related to memory and cognition." Barth's three-year \$300,000 award will be used to study experience dependent changes in cells and connections between cells to understand how this process contributes to learning and memory.

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Marlene Cohen (Pitt Neuroscience) received the 2012 \$25,000 Grand Prize in the Eppendorf and Science Prize for Neurobiology. The award recognizes outstanding research by young scientists. The prize highlights Cohen's work on attention, as detailed in the Prize essay, "When Attention Wanders" published in the October 5th issue of *Science* (2012). The essay discusses her work examining the activity of neurons and showing how attention's wandering led to specific changes in perception. In a one-two coup for the CNBC, Aryn Gittis (CMU Biology) was a finalist for the Grand Prize for her essay "Striatal Interneurons: Causes or Cures for Movement Disorders?" also published in the October 5th issue of *Science*. For more on Gittis, see the article on new faculty hires, this issue.

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Lori Holt (CMU Psychology) has received the 2013 National Academy of Sciences Troland Research Award and joins past CNBC winners Michael Tarr (CNBC CMU Co-director) and David Plaut (CMU Psychology). As stated on the National Academy website, the award is "given to young investigators (age 40 or younger) to recognize unusual achievement and further empirical research in psychology regarding the relationships of consciousness and the physical world." Holt was awarded the \$50,000 prize in recognition of "studies advancing our understanding of the sensory and cognitive processes that are fundamental to the perception of speech."

Lori Holt (CMU Psychology) has received the 2013 National Academy of Sciences Troland Research Award and joins past CNBC winners Michael Tarr (CNBC CMU Co-director) and David Plaut (CMU Psychology). As stated on the National Academy website, the award is "given to young investigators (age 40 or younger) to recognize unusual achievement and further empirical research in psychology regarding the relationships of consciousness and the physical world." Holt was awarded the \$50,000 prize in recognition of "studies advancing our understanding of the sensory and cognitive processes that are fundamental to the perception of speech."

## Supporting Undergraduate Participation in the CNBC

At Carnegie Mellon University, the Brain, Mind, and Learning initiative, launched in 2011, embodies the University's goal of expanding its strengths in the brain and behavioral sciences. This reflects CMU's growing interest in applying its world-class expertise in the computational sciences to the study of biological systems. This initiative and similar programs at the University of Pittsburgh promote the educational goals of the CNBC. For example, the Brain, Mind, and Learning (BML) Innovation Fund at CMU, has contributed to improved undergraduate education and research in the neural and behavioral sciences. Thanks to the generosity of nearly fifty donors, CMU will roll out several new courses in the neurosciences in 2014. Participating faculty include members of Biological Sciences, the School of Computer Science, the CNBC, and Psychology. These courses will serve both undergraduates interested in pursuing upper-level courses in the brain and behavioral sciences as well as students from across the university, regardless of major who are interested in learning more about the mind and brain. Such courses will add a new dimension to the joint undergraduate majors offered by the Departments of Biological Sciences and Psychology, both of which are generating significant enthusiasm among the freshman and sophomores.

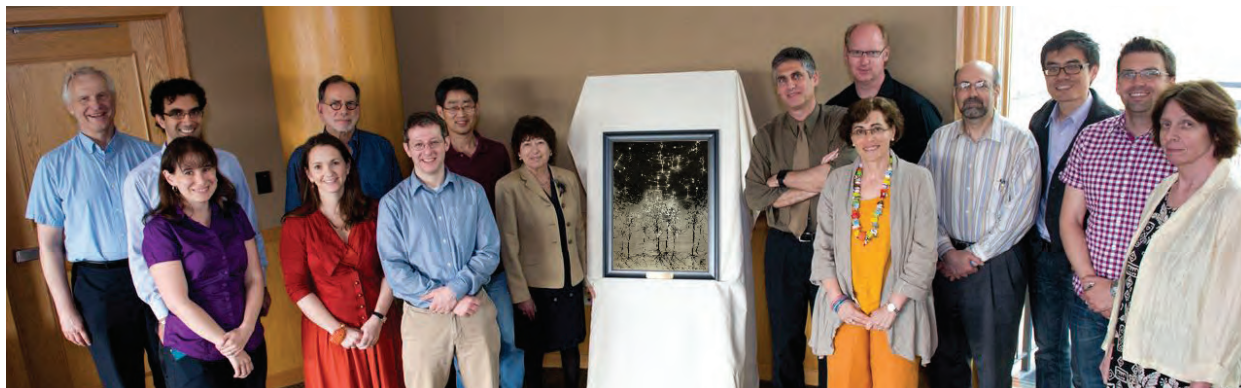
Support to both CMU and the University of Pittsburgh also supports the CNBC's diverse Undergraduate Summer Research Experience programs that allow undergraduates from both the CNBC community and from other universities to spend the summer working with a faculty mentor in CNBC labs at both Pitt and CMU. Students receive stipends, attend lectures, and participate in research that often leads to scientific publications. Along with helping to introduce top-quality students from around the world to hands-on research in a wide array of areas, this training program helps highlight the many world-class graduate programs in Pittsburgh available to these trainees.

For more information about the BML Innovation fund at CMU, please contact Peter Cohen, Senior Director of Strategic Initiatives, at [pfcohen@andrew.cmu.edu](mailto:pfcohen@andrew.cmu.edu).

For more information about supporting the CNBC at the University of Pittsburgh, please contact Kellie S. Anderson, Executive Director, Central Development, at [akellie@pmhsf.org](mailto:akellie@pmhsf.org).

## Leslie Ungerleider

*Recipient of the Andrew Carnegie Prize  
in Mind and Brain Sciences*



(Left to Right) Walter Schneider, Avniel Ghuman, Marlene Cohen, Lori Holt, Peter Strick, Steve Chase, Seong-Gi-Kim, Leslie Ungerleider, Mike Tarr, Nathan Urban, Marlene Behrmann, David Touretzky, Wayne Wu, Tim Verstynen and Carol Colby

Leslie G. Ungerleider, Chief of the Laboratory of Brain and Cognition at the National Institutes of Health, has received the first Andrew Carnegie Prize in Mind and Brain Sciences. The prize is made possible by a \$750,000 award from the Carnegie Corporation of New York as part of their centennial celebration. The Carnegie Prize in Mind and Brain includes a public lecture, a painting by Greg Dunn, and a graduate fellowship named in the recipient's honor. Tina Liu, who will work with Marlene Behrmann (CMU Psychology and CNBC), will be the recipient of the 2014 Leslie Ungerleider Fellowship. The fellowship provides funds to visit Ungerleider's laboratory to foster continued collaboration with the prize recipient.

Leslie Ungerleider completed her PhD in experimental psychology at New York University and then a post-doc with Karl Pribram at Stanford. In 1975, she moved to the NIMH where, with Mortimer Mishkin, she identified two cortical visual systems in primates, a dorsal stream computing spatial information (the *where* stream) and a ventral stream computing object identity (the *what* stream). This work has been fundamental to vision science. Since then, she has gone on to work on different aspects of the visual system including face recognition, object representation, and visual working memory. In addition to serving as Chief of the Laboratory of Brain and Cognition, her other notable honors include election to the National Academy of Sciences (2000), to the American Academy of Arts and Sciences (2000), and appointment as an NIH Distinguished Investigator (2008).

Mike Tarr, CMU co-director of the CNBC, notes that "Dr. Ungerleider has been at the forefront in the field of cognitive neuroscience for over three decades. Her research on the functional organization of the primate visual system has been immensely influential to generations of brain scientists."

In the prize ceremony on May 23, 2013, Ungerleider presented a lecture on "The Functional Architecture of Face Processing in the Primate Brain." She was also presented with a framed painting by Greg Dunn entitled "What and Where" that depicts properties of the two visual pathways

that Ungerleider identified. The picture incorporates holographic elements (see below). Ungerleider's lecture provided an opportunity for members of the CNBC community to hear about her current work and to celebrate the achievements of a remarkable scientist. Additional Carnegie Prizes will be presented over the next 10 years and will facilitate further interactions between the CNBC community and prominent cognitive scientists.



*What and Where, 2013, 18" x 24"  
Ink on 12K gold and stainless steel  
Dr. Greg Dunn  
www.gregdunn.com*

To view the demonstration of scratch holography visit:  
<http://vimeo.com/69814130>

## Honors & Awards

### Faculty

**Kevin Chan** was selected as an Associate Editor of *Journal of Magnetic Resonance Imaging* 2012 and promoted to Deputy Editor in 2013

**Steven Chase** was awarded a Wimmer Faculty Fellowship for 2013-2014

**X. Tracy Cui** received the Carnegie Science Award Emerging Female Scientist 2013

**Avniel Ghuman** received a NARSAD Young Investigator Award from the Brain and Behavior Foundation

**Brant P. Hasler** received a K01 Career Development Award from NIDA, "Circadian Misalignment and Reward Function: A Novel Pathway to Substance Use"

**Marcel Just** was appointed as a University Professor at Carnegie Mellon 2013, and received the Distinguished Scientific Contribution Award from the Society for Text and Discourse, 2012

**Rob Kass** received the Outstanding Statistical Application Award from the American Statistical Association (ASA)

**Roberta Klatzky** was named the Charles J. Queenan Jr. Professor of Psychology

**Anthony E. Kline** was named a Fellow of the International Behavioral Neuroscience Society

**Edouard Machery** was awarded the Stanton Prize by the Society for Philosophy and Psychology

**Nancy Minshew** received the Carnegie Science Center Catalyst Award 2013

**Mike Modo** was awarded the Bernard Sanberg Memorial Award for Brain Repair by the American Society for Neural Transplantation and Repair

**Joel Schuman** received the American Academy of Ophthalmology's Life Achievement Honor Award 2013

**Greg Siegle** was the John and Sally Morley Family Foundation Lecturer at Case Western Reserve 2013 & G. Kirby Collier Lecturer at the University of Rochester 2012

**Peter Strick** received the Chancellor's Distinguished Research Award, Senior Scholar, 2013

### Ph.D.s

**Nicholas Alba**, 4/3/2013, PITT Bioengineering (Cui)

**Blair Armstrong**, 7/13/2012, CMU Psychology (Plaut)

**Andreea Bostan**, 7/25/2013, PITT CNUP (Strick)

**Lucia Castellanos**, 8/19/2013, CMU Machine Learning (Kass)

**Jingyuan Huang**, 7/12/2012, CMU Psychology (Holt)

**Amanda Kinnischtzke**, 7/8/2013, PITT CNUP (Simons)

**Roma Konecky**, 12/19/2012, Pitt CNUP (Olson)

**Daniel Leeds**, 7/22/2013, CMU Neural Computation (Tarr)

**Karen Munoz**, 9/9/2012, PITT Psychology (Gianaros)

**Catherine Stinson**, 8/9/2013, PITT History & Philosophy of Science (Schaffner & Machamer)

**Krishna Subramanian**, 8/22/2013, PITT CNUP (Cameron)

**Gustavo Sudre**, 12/13/2012, CMU Neural Computation (Mitchell)

**Maggie Sweitzer**, 4/15/2013, PITT Psychology (Donny)

**Shreejoy Tripathy**, 9/18/2013, CMU Neural Computation (Urban)

**Lindsay Victoria**, 5/23/2013, CMU Psychology (Tarr)

**Matthew Walsh**, 8/23/2012, CMU Psychology (Anderson)

**David Whitney**, 7/19/2013, CMU Biological Sciences (Kim & Crowley)

**Bronwyn Woods**, 8/14/2013, CMU Neural Computation & Statistics (Eddy)

**Yang Xu**, 8/21/2013, CMU Machine Learning (Kass & Tarr)

**Yevdokiya "Dussy" Yermolayeva**, 6/18/2013, CMU Psychology (Rakison)

### PostDocs

**Layla Banihashemi** was an invited speaker at the 2013 APA Convention: Symposium on Neurological and Physiological Implications of Maltreatment

**Corina Bondi** received the Top Poster Presentation Award at the 11th Annual Peter Safar Symposium, University of Pittsburgh

**Adam Greenberg** was hired as a tenure-track Assistant Professor in the Psychology Department & Neuroscience Program at the University of Wisconsin-Milwaukee

**Rebecca Price** received a K Award from NIMH, "Neural Dimensions of Attention Bias Modification for Transdiagnostic Anxiety"

### 2012 Retreat "Most Outstanding Poster Awards"

*Marvin Leathers, Jineta Banerjee, Shanna Bowersox, and Alan Degenhart*

