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April 26, 2012

Professor David Sheinberg, Ph.D
Search Committee Chair
Department of Neuroscience
Brown University
Providence, RI 02912

Dear Professor Sheinberg:

I am applying for the Tenure-Track Assistant Professor position in Computational Neuroscience recently advertised by the Department of Neuroscience at Brown University via the Connectionists mailing list.

I received my Ph.D. in Neuroscience in 2009 from the University of Pittsburgh and am currently a postdoctoral researcher at the Johns Hopkins University. My research has focused on improving our understanding of Reinforcement Learning and its implications for Neuroscience. Although Reinforcement Learning has already shown itself to be relevant and valuable as a theoretical framework, I propose that deep insights will come from understanding how Reinforcement Learning computations are implemented using neural network mechanisms.

In addition to my work in Computational Neuroscience, my research experience has included extensive collaborations with experimentalists and clinicians. My current appointment is in a behavioral and fMRI laboratory, where I am conducting a number of experiments that are motivated in part by my prior modeling work. In addition I have had the good fortune to be involved with other groups at Johns Hopkins. I recently trained a senior graduate student in Ed Connor's laboratory in model-based fMRI analysis for a study of visual object perception. On the clinical side, I have been collaborating with Dean Wong's group on a PET scanning experiment involving normal participants and cocaine addicts.

I note that the advertisement encourages applications from minorities. I would therefore at this point like to indicate that I am of African-American descent.

Thank you in advance for your consideration. I look forward to hearing from you.

Sincerely,

Patryk Laurent, Ph.D.

Enclosures: CV, Research Statement, Teaching Statement, Publications.

Patryk A. Laurent, Ph.D

Department of Psychological and Brain Sciences
The Johns Hopkins University
Baltimore, MD 21218 U.S.A.

Phone: 412-576-1595
email: laurent@jhu.edu
URL: http://pakl.net/
Born: May 17, 1978—NY, USA [Nationality: American (USA)]

Current position

Postdoctoral Researcher (Yantis Laboratory), The Johns Hopkins University.

Research focus

Neurocomputational Models of Reinforcement Learning, Memory, and Attention.

Teaching interests

Introduction to neural networks; Computational modeling of cognitive processes; Psychobiology; Introduction to cognitive neuroscience; Introduction to cognitive psychology; Functional neuroimaging seminar.

Education

2009 Ph.D in Neuroscience, University of Pittsburgh (CNUP).
Basal Ganglia Involvement in the Reinforcement Learning of Physical and Cognitive Actions.
(**Dissertation Supervisor**: Dr. Erik Reichle)

2009 Training Certificate, Center for the Neural Basis of Cognition Certificate (CNBC). Carnegie-Mellon University & University of Pittsburgh.

2001 BA in Cognitive Sciences, University of Virginia.

Appointments held

2009- *Postdoctoral Researcher* (Yantis Lab), Psychological and Brain Sciences, The Johns Hopkins University.

2003-2009 *Graduate Student Researcher*, Center for Neuroscience, University of Pittsburgh (CNUP).

1997-2000 *Undergraduate Researcher*, Laboratory of Systems Neurodynamics (Levy Lab), University of Virginia.

Grants, honors & awards

2006-2008 NSF IGERT (stipend and fMRI study funding) (Center for the Neural Basis of Cognition)

2003-2004 Predoctoral Fellowship, Center for Neuroscience (University of Pittsburgh).

2001 Batten Institute business incubator award, Darden School of Business (University of Virginia).

1999 Harrison Award (Center for Undergraduate Excellence, University of Virginia).

1997-2001 Jerome Holland Scholarship [link to information] (University of Virginia).

1997-2001 Echols Scholar Award (University of Virginia).

Publications

Peer-Reviewed Articles

(submitted) **Laurent, P. A.** (submitted) A Neural Mechanism for Reward Discounting: Insights from Modeling Hippocampal-Striatal Interactions.

(submitted) **Laurent, P. A.**, Reichle, E. D. (submitted) Motor and non-motor reward-related signals in the striatum.

(in press) Anderson, B. A., **Laurent, P. A.**, & Yantis, S. (in press) Generalization of Value-Based Attentional Priority, Visual Cognition.

2011 Anderson, B. A., **Laurent, P. A.**, & Yantis, S. (2011) Learned value magnifies salience-based attentional capture. PLoS ONE 6(11): e27926 (doi:10.1371/journal.pone.0027926)

2011 Anderson, B. A., **Laurent, P. A.**, & Yantis, S. (2011) Value-driven attentional capture. PNAS, 108(25):10367-10371. (doi:10.1073/pnas.1104047108)

2008 **Laurent, P. A.** (2008) The emergence of saliency and novelty responses from reinforcement learning principles. Neural Networks, 21:1493-1499. (doi:10.1016/j.neunet.2008.09.004)

2008 Reichle, E. D., Vanyukov, P. M., **Laurent, P. A.**, & Warren, T. (2008) Serial or parallel? Using depth-of-processing to examine attention allocation during reading. Vision Research, 48: 1831-1836. (doi:10.1016/j.visres.2008.05.007)

2006 Reichle, E. D. & **Laurent, P. A.** (2006) Using reinforcement learning to understand the emergence of "intelligent" eye-movement behavior during reading. Psychological Review, 113: 390-408. (doi:10.1037/0033-295X.113.2.390)

2003 Mitman, K. E., **Laurent, P. A.**, & Levy, W. B (2003) Defining time in a minimal hippocampal CA3 model by matching time-span of associative synaptic modification and input pattern duration. Proceedings of the International Joint Conference on Neural Networks (IJCNN). (doi:10.1109/IJCNN.2003.1223651)

Invited Articles and Book Chapters

in press Yantis, S., Anderson, B. A., Wampler, E. K., & **Laurent, P. A.** (in press). Reward and Attentional Control in Visual Search. Nebraska Symposium on Motivation 2011: The Influence of Attention, Learning, and Motivation on Visual Search.

2011 Reichle, E. D., Liu, Y., & **Laurent, P. A.** (2011). The emergence of adaptive eye movement control in reading: Theory and data. Studies of Psychology and Behavior, 9, 45-52.

Manuscripts in Preparation

(in prep.) **Laurent, P. A.**, & Bostan, A. C. (in prep.) A theory on the computational role of cerebellum-basal ganglia interaction.

(in prep) **Laurent, P. A.**, Cho, S. Y., & Yantis, S. (in prep) Basal ganglia involvement in the cognitive act of task switching.

(in prep.) **Laurent, P. A.**, Anderson, B. A., & Yantis, S. (in prep.) Value-Driven Attentional Capture by Oriented Gabors.

Posters & Abstracts

2011 **Laurent, P. A.** & Bostan, A. C. (2011). Stabilizing Reinforcement Learning in the brain: A proposed function of the bidirectional cerebello-basal ganglia projection. Annual Meeting of the Society for Neuroscience (Washington DC). 723.27.

2010 **Laurent, P. A.** & Reichle, E. D. (2010). Localization of physical and cognitive reinforcement signals in the striatum. Annual Meeting of the Society for Neuroscience (San Diego, CA) 801.4.

2010 Cho, S., **Laurent, P. A.**, & Yantis, S. (2010). Subcortical mechanisms of cognitive control in task switching. Annual Meeting of the Society for Neuroscience (San Diego, CA) 501.7.

2008 **Laurent, P. A.**, Reichle, E. D., & Fiez, J. A. (2008, November). Does parallel anatomy translate to parallel computation in the basal ganglia? Annual Meeting of the Society for Neuroscience (Washington DC) 680.9.

2008 Warren, T., Patson, N. D., **Laurent, P. A.**, & Reichle, E. D. (2008, November). Revisiting length and predictability effects on eye movements in reading. 49th Annual Meeting of the Psychonomic Society (Chicago, IL).

2008 Cole, M. W. & **Laurent, P. A.** (2008, November). Neurevolution: an example of blogging to enhance scientific communication. Annual Meeting of the Society for Neuroscience (Washington DC). 227.6.

2007 **Laurent, P. A.** (2007). Using reinforcement learning to interpret the non-reward phasic dopamine response. Annual Meeting of the Society for Neuroscience (San Diego, CA). 530.10.

2007 Vanyukov, P. M., Reichle, E. D., **Laurent, P. A.**, Morales, F. J., & Warren, T. (2007). Serial or parallel? Using depth of processing to examine attention allocation during reading. European Conference on Eye Movements (ECEM 14) (Potsdam, Germany).

2006 **Laurent, P. A.** & Reichle, E. D. (2006). Using Reinforcement-Learning Agents to Examine the Allocation of Attention During Reading. Architectures and Mechanisms for Language Processing (AMLaP 2006) (Nijmegen, Holland).

2004 Phillips, J. P., **Laurent, P. A.**, Guediche, S. A., Bolger, D. J., Qin, L., Perfetti, C. A., & Fiez, J. A. (2004). Reliable word identification may modulate the response to visually presented words in the left fusiform gyrus. Annual Meeting of the Society for Neuroscience (San Diego, CA). 80.11.

2004 Reichle, E. D. & **Laurent, P. A. (2004)**. The emergence of "intelligent" eye-movement control during reading: a computational account. Architectures and Models of Language Processing (AMLaP 2004) (Aix-en-Provence, France).

Talks

2012 **Laurent, P. A.** (2012) Understanding Reward Delay Discounting as Emerging from Interactions between Hippocampal and Striatal Neural Networks. *To be presented at* the Sixteenth

International Conference on Cognitive and Neural Systems (ICCNS16) (Boston, MA).

2010 Anderson, B. A., **Laurent, P. A.**, & Yantis, S. (2010) Reward-Driven Attentional Capture. 51st Annual Meeting of the Psychonomic Society (St. Louis, MO). 170.

2009 **Laurent, P. A.** & Reichle, E. D. (2009). Evaluating Reinforcement Learning of Hand Movements, Eye Movements, and Covert Shifts of Attention in Humans: A model-based fMRI study. 15th European Conference on Eye Movements (ECEM15) (Southampton, England).

2009 **Laurent, P. A.** & Reichle, E. D. (2009) Using reinforcement learning to examine word-parsing strategies in the reading of Chinese. 15th European Conference on Eye Movements (ECEM15) (Southampton, England).

2007 **Laurent, P. A.** & Reichle, E. D. (2007). Serial or parallel? Using Reinforcement Learning to examine attention allocation during reading. Symposium on Computational Models of Eye-Movement Control, 14th European Conference on Eye Movements (ECEM14) (Potsdam, Germany).

2006 **Laurent, P. A.** & Reichle, E. D. (2006). Using Reinforcement Learning to understand eye-movement control during reading. Invited Colloquium, Institute of Computing Science, Poznan University of Technology (Poznan, Poland).

2006 Reichle, E. D. & **Laurent, P. A.** (2006). Using Reinforcement Learning to understand eye-movement behavior during reading. Invited Colloquium, ECRP Workshop: Eye Movements in Reading: Computational Models & Corpus Analyses, University of Potsdam (Germany).

2005 **Laurent, P. A.** & Reichle, E. D. (2005). The emergence of 'intelligent' eye-movement control in reading: A Reinforcement Learning Model. Invited Colloquium at Department of Psychology, University of Pittsburgh.

2005 Reichle, E. D. & **Laurent, P. A.** (2005). Using Reinforcement Learning to understand the emergence of 'intelligent' eye-movement behavior during reading. 13th European Conference on Eye Movements (ECEM13) (Berne, Switzerland).

Teaching experience

2012, fall *Co-Instructor with Dr. Chase Figley*, Functional Neuroimaging Graduate Seminar AS 200.615 (Deptartment of Psychological and Brain Sciences, The Johns Hopkins University).

2010-2011 *Instructor* (4 semesters). Functional Neuroimaging Graduate Seminar AS 200.614/5 (Deptartment of Psychological and Brain Sciences, The Johns Hopkins University).

2010, spring *Instructor*, Tutorial Introduction to fMRI Analysis using AFNI (The Johns Hopkins University).

2008, fall *Guest lecturer*, Psychology 0035: Research Methods (Instructor: Erik Reichle; University of Pittsburgh).

2006, fall *Guest lecturer*, Psychology 0420/0421: Cognitive Psychology for Majors and Non-Majors (Instructor: Erik Reichle; University of Pittsburgh).

2006, spring *Teaching Assistant*, Neurophysiology 1012/2012 (Instructor: Jon Johnson; University of Pittsburgh).

Research Supervision and Mentoring

2011-2012 *Ms. Taylor Chamberlain*. River Hill High School, Clarksville, MD.
Introduction to research methods and neural network modeling.

2011-2012 *Dr. Neeraja Balachander*. Mind-Brain Institute, The Johns Hopkins University.
Tutoring on fMRI analysis methodology and scientific writing.

2010-2011 *Ms. Stacy Kang*. Masters in Cognitive Psychology, The Johns Hopkins University.
Tutoring on fMRI analysis methodology.

2009-2010 *Mr. Stephen Walenchok*. Undergraduate research in Psychology, University of Pittsburgh.
Involved in my dissertation research, provided mentoring during development of honors thesis project.

Professional service

2010 Outside examiner, Ms. Sarah Orban's undergraduate honors thesis committee. (Department of Psychology, Honors College, University of Pittsburgh).

2010 Outside examiner, Mr. Steve Walenchok's undergraduate honors thesis committee. (Department of Psychology, Honors College, University of Pittsburgh).

2009 Symposium chairperson, European Conference on Eye Movements (ECEM15).

2009 Trainee, Society for Neuroscience Advocacy Training ("Capitol Hill Day", Washington DC).

2008 Student Representative, IGERT PI Meeting, National Science Foundation (Arlington, VA).

2004-2005 Student Representative, Education Committee, Center for the Neural Basis of Cognition (Pittsburgh, PA).

Ad hoc reviewer for: Attention, Perception & Psychophysics; Cortex; Journal of Cognitive Neuroscience; Neural Networks

Professional affiliations

Society for Neuroscience
Vision Sciences Society

Patents and Intellectual Property

2005 **Laurent, P. A.**, Lewis, B. M., & Poush, A. G. (2005). Analysis of time-series data from an electric power-producing asset for the inference of well-defined overlapping modes. United States Patent Office Patent and Trademark Office 2005/0209799A1

2005 Lewis, B. M., **Laurent, P. A.**, & Poush, A. G. (2005). Method for the automated quantification of power production, resource utilization and wear of turbines. United States Patent Office Patent and Trademark Office 2005/0171704A1

Other work experience

2002-2003 *Software Developer*, Super Natural Tools, Inc. (Roanoke, VA).
Developed data analysis algorithms and data visualization software.

2000-2002 *Software Developer*, Inductive Logic, Inc. (Charlottesville, VA).
Implemented natural language processing algorithms for stock sentiment analysis.

1997-2000 *Software Developer*, ScholarOne, Inc.; Carden Jennings Publishing (Charlottesville, VA).
Developed ManuscriptCentral™ and AbstractCentral™ manuscript submission systems.

Research Statement

There is tremendous interest in using Reinforcement Learning (RL) to understand brain function and dysfunction. One reason for this is that RL models generate quantitative hypotheses that have been successfully evaluated using behavioral and neuroscientific techniques. However, interest in RL is tempered by the fact that its models are implemented using abstract mathematical equations. The variables and parameters in these equations have not been mapped to neural substrates; this lessens their usefulness in the context of Computational and Cognitive Neuroscience. What is missing are viable proposals for neural network mechanisms that might underlie RL computations.

My research program aims to identify and develop biologically-inspired neural network models targeted at explaining specific RL phenomena. Some of the specific questions that I intend to investigate include:

1. How are reward prediction values rapidly learned and stably stored in neural networks?
2. What neural network mechanisms give rise to reward delay discounting?
3. How are novelty, saliency, and reward-prediction error signals successfully multiplexed in RL circuits?

Research Program

RL refers to the problem of learning to optimally select actions in order to maximize a scalar reward signal, and also to algorithms used for solving this problem. In Neuroscience, RL is a theoretical framework that formalizes the link between perception, cognition, action and reward. As a framework, RL has been very successful at explaining decision-making behavior in a variety of experimental tasks. It has also generated predictions for neural activity in the dopamine system and basal ganglia – which have been borne out in studies using electrophysiological and neuroimaging techniques. However, there are many aspects of RL that have yet to be ascribed to particular neural networks in the brain.

Recent evidence is suggestive of brain regions beyond the basal ganglia being involved in RL computations. The three projects I propose below involve the elaboration of neural network models aimed at developing specific hypotheses about the involvement of these other brain regions in RL. (Developing models requires much in terms of resources and time. Because my approach involves studying how multiple brain regions interact, my strategy is to use established models from other laboratories and focus on integrating them.)

(1) Accelerating and Stabilizing Reward Prediction Learning in Neural Networks. According to RL theory, the ability to learn reward predictions is an essential part of decision-making. Most RL algorithms require storing associations between states or actions, and reward predictions. Typical implementations store associations in databases called 'lookup tables' (e.g., Reichle & Laurent, 2006; Sutton & Barto, 1998), but it is widely acknowledged by computer scientists and engineers that it is desirable to use artificial neural networks instead to reduce memory requirements and benefit from generalization. For Neuroscience research, the use of neural networks is especially interesting because the algorithms become more biologically realistic. Unfortunately, the direct use of artificial neural networks in RL algorithms is prone to slow and unstable learning that can result in poor decision-making behavior.

The difficulty in getting artificial neural networks to succeed in RL poses challenges for understanding how the brain's neural networks carry out reward-related learning. For artificial neural networks that learn using gradient descent, however, computer scientists have proposed a solution that involves adding a second gradient to the learning algorithm. This additional gradient corresponds to a correction for anticipated errors in successive reward predictions when the network is updated by reward feedback (Baird, 1999). This correction is analogous to the kind of error-correction learning that is commonly thought to be performed by the **cerebellum** for sensorimotor states. Although classically the cerebellum and basal ganglia are each thought to operate separately on the neocortex (e.g., Doya, 2000), recent evidence shows that the cerebellum and basal ganglia in fact possess a bidirectional connection that does not go through neocortex (Bostan et al., 2010; Hoshi et al., 1995). The work by Baird and others has led me to propose that this newly discovered projection is involved in correcting for errors in successive reward predictions in the brain, as a means for stabilizing and accelerating reward learning. Analysis of simulations suggest that this putatively cerebellar contribution is especially important in tasks where rewards or effort are scaled, analogous to a "reward prism adaptation" effect (Laurent & Bostan, 2011 SfN poster presentation).

(2) A Neural Network Basis for Reward Delay Discounting. Successful human decision-making involves balancing immediate gains against long-term rewards, a phenomenon termed *reward delay discounting*. In neurologically intact organisms ranging from pigeons, to non-human primates, to humans, the value of a delayed rewarding stimulus follows a decreasing hyperbolic function in time (Mazur & Biondi, 2009). However there is little in terms of proposed neural network-level mechanisms to explain reward discounting.

One possible neural source of reward discounting is the **hippocampus**, a brain structure known to be involved in learning, memory, and sequence prediction. Hippocampal lesions interfere with reward-delay discounting (Gupta et al., 2009; Mariano et al., 2009; Cheung & Cardinal, 2005; Rawlins et al., 1985). A recent fMRI study showed that discounting can be experimentally modulated in normal human participants by having them consider future events, an effect that was accompanied by increases in functional connectivity between prefrontal cortex and hippocampus (Peters & Büchel, 2010). However it remains unknown how precisely the hippocampus allows anticipated reward to influence current decision-making about rewards. Using an established model of the hippocampal function (Levy et al., 2005; Levy, 1996) and modeling its influence on the striatum (Pennartz et al., 2004), I am developing a model of how hippocampus may contribute to reward delay discounting (Laurent, submitted; enclosed). Once established this model will allow us to generate and test the effects of attention, salience, and hippocampal dysfunction on reward predictions, substantially expanding the relevance of RL theory within Neuroscience.

(3) Integration of Reward and Novelty Signals with Reward-Prediction Errors. It is well-established that phasic dopamine transmits a signal that reflects reward-prediction errors: Dopamine will increase above baseline when rewards are unpredicted or larger than predicted, but will decrease below baseline when predicted rewards are omitted or smaller than predicted (Schulz, 1998; Hollerman, et al., 1998). These effects also occur for stimuli that have become associated with reward or loss. However, stimuli that are not necessarily associated with reward but that are novel or salient also generate positive phasic dopamine, even if those stimuli are aversive. For example, loud sounds and bright lights cause phasic dopamine responses and corresponding orienting behavior – as though they were rewarding.

Although reward-prediction and novelty/saliency responses appear to be orthogonal, theoretical work has suggested that instead, they are tightly related to each other (Laurent, 2008; Kakade & Dayan, 2002). These findings suggest that RL algorithms implemented in the brain can successfully multiplex phasic dopamine signals arising from multiple causes. To understand how this works in a system of neural networks, I propose to simulate responses in **neocortex** to novel and salient stimuli using settling time in excitatory-inhibitory networks (e.g., Ho & Rouat, 1998). Simulations of reward-learning tasks will provide predictions about the interactions of the neocortex and the striatum. This project therefore aims to distinguish novelty and saliency signals from reward-related signals within an integrated RL-based framework.

Teaching Statement

Teaching is an important responsibility of scientists and academics, and I have always endeavored to give it priority. My teaching philosophy is based on providing students with an understanding of the reasoning and methods used to discover knowledge, rather than an emphasis on memorization of that knowledge per se. This philosophy originates from my belief that learning and scientific research are both driven by the same basic underlying forces: curiosity, motivation, and creativity. These forces are almost exactly opposed by rote memorization and multiple-choice examinations. Although it is challenging and time-consuming to design and grade exams around this philosophy, I believe that the outcome is well worthwhile.

For example, in teaching science and mathematics, I prefer to take the approach of focusing on realistic research questions to think about and solve in the classroom setting. Because students now have easy access to computers and mathematics software, they can analyze data from real (anonymized) studies as part of their lectures and exercises. This hands-on experience will increase their engagement with study material.

Finally, another important way to teach is by engaging undergraduates in research in the lab. To do this, I would like to recreate an environment similar to the one that initially got me interested in research: a laboratory that involves undergraduates in research, working alongside graduate students and postdocs.

Teaching Experience

As my CV indicates, I have had a number of opportunities to teach in formal classroom settings, in the lab, and in the broader university community.

In the formal classroom setting, I have served (1) as a teaching assistant, (2) as a guest lecturer for undergraduate classes, (3) as a co-instructor on an fMRI tutorial session for graduate students and postdocs, and (4) as the lead instructor of a graduate neuroimaging seminar (which has also included some advanced undergraduates). The teaching assistant role focused on holding office hours, grading, and updating course materials to correspond to what was covered in the lectures. The guest lectures involved presenting material from book chapters and prior lecture outlines. For the fMRI tutorial session, I prepared tutorial materials for a sample dataset and lectured students on typical fMRI analysis procedures using AFNI. The graduate seminar involved helping students select, understand, and discuss articles using interesting and novel fMRI methodologies. Although each of these teaching experiences required preparation and work, I greatly enjoyed the opportunities to work directly with students.

In addition, at the Johns Hopkins University, there is an opportunity to teach a 3-week "intersession" course during the month of January. Along with another post-doc, I submitted an application proposing a new introductory course on Neural Network Models of Cognition, targeted at undergraduate students in neuroscience and psychology. Our goal in this course is to give the students a taste of some of the more exciting capabilities of neural networks, like associative memory, categorization, sequence learning, and prediction. To help ensure the course is a good fit for the undergraduates, I contacted the director of the BA/MS program in Neuroscience at Johns Hopkins. I plan to submit the course for consideration next semester.

Research Mentoring

I have had opportunities to mentor three students in the laboratory setting: one at the graduate level, one at the undergraduate level, and one senior high school student.

While at the University of Pittsburgh, I met a third-year undergraduate student named Mr. Steve Walenchok who expressed an interest in cognitive psychology. After several discussions, I involved him in my dissertation project.

This gave him experience in instructing research participants, in collecting data using behavioral response times and eye tracking, and preliminary experience in running fMRI experiments. Towards the end of my dissertation project, I told Steve that my fMRI results suggested that saccadic eye movements and covert attention shifts could be reinforced using independent brain circuits. He was very intrigued by this possibility, especially once I told him that this might violate the "premotor theory of attention" (a theory which, briefly, states that covert visual attention is equivalent to planning a saccadic eye movement which can later be canceled). Steve and I regularly held debriefing sessions in my office where we'd review the day's data collection. During these meetings, Steve and I developed a follow-up experiment that would test whether humans could learn to perform saccadic eye movements without first shifting their covert attention – which would be a violation of the premotor theory. Using the resources of my graduate advisor's laboratory, Steve implemented this experiment for his honors thesis. I am pleased to report that Steve has submitted a manuscript on the results of this work for publication, and is currently completing his first year of graduate school at Arizona State University.

The second student I had the opportunity to mentor in a laboratory setting was a second-year graduate student named Ms. Stacy Cho, here at the Johns Hopkins University. She was the first member of the laboratory to foray into fMRI of the basal ganglia during task switching as part of a new research direction. I helped her overcome a number of new challenges that arose during data analysis: the combination of the focus on subcortical structures and a modified experimental design meant that new tools and approaches had to be used. Despite the fact that her initial analyses produced results that appeared to deviate from prior results in the lab, I encouraged her to continue to look closely at the data. She discovered that motor responses at other times during the experiment (i.e., responses to the targets) had caused the elevated baseline throughout the dataset. Once these motor responses were modeled, the task-switching responses were much more in keeping with prior findings in the lab. I am pleased to report that we are close to submitting a manuscript based on these data, and that Stacy successfully obtained her master's degree and is currently working for a company involved in pre-operative neuroimaging.

Most recently, I have begun advising a high school senior on a computational neuroscience modeling project. Ms. Taylor Chamberlain is interested in cognitive psychology and neuroscience, but has expressed specific interest in computational modeling and computer science. The project we are working on involves studying the kinds of representations that form in neural networks with many layers. Taylor is taking programming in her high school curriculum, and she has been able to apply knowledge from those classes to research by correctly modifying source code for new variants of simulations.

Other Mentoring

In addition to the three students listed above, I have had the opportunity to tutor three graduate students across the Johns Hopkins university community to assist them with their computational analyses of neuroimaging data. This tutoring involved helping the students learn to use a Unix-based fMRI analysis tool called AFNI, for analyses of data they had collected. The most recent one, Ms. Neerja Balachander, has recently defended her PhD based on the fMRI project. In all three cases, I was able to improve the graduate student's understanding of fMRI data analysis and help them bring their work closer to a publishable state. I look forward to an opportunity to make this, and other kinds of teaching, an official part of my job.