



ARIEL AMGOTT-KWAN
Berkeley, California

Honors Advisor: Tracie Paine

Does Methylphenidate Attenuate Rp-cAMPS Induced Inattention and Hyperactivity?

Attention deficit hyperactivity disorder (ADHD) is characterized by inattention, hyperactivity and impulsivity (American Psychiatric Association, 2000). While there are a number of ADHD treatments currently available their mechanisms of action are widely unknown. Current medications are also riddled with a number of untoward side effects often leading to non-compliance. Stimulant therapies (amphetamines and methylphenidate) are the most widely prescribed treatment for ADHD and are associated with large clinical effects and low abuse potential (Wigal, 2009). Methylphenidate (Ritalin) results in elevated extracellular levels of dopamine (DA) and norepinephrine (NE) through its inhibition of norepinephrine and dopamine reuptake transporters (NET and DAT). The therapeutic efficacy of these drugs is thought to result from their actions within the prefrontal cortex (PFC) (Arnsten, 2009). Indeed, DA D1 receptor antagonism in this brain area disrupts attention in rodent models (Granon *et al.*, 2000). Activation of D1 receptors enhances protein kinase A (PKA) through coupling G_s g-proteins. Like the effect of D1 antagonism, blockade of PKA in the PFC by Rp-cAMPS decreases attention, as measured by the 5-choice serial reaction time task, and increases locomotor activity (Paine *et al.*, 2009). This evidence supports the notion that the PFC plays a significant role in the regulation of attention and locomotor activity. Since stimulant medications, such as methylphenidate, increase extracellular DA in this brain area and may also increase cortical PKA activity. The objective of my thesis is to determine whether methylphenidate administration can reverse the deficits caused by cortical PKA inhibition. Understanding this molecular mechanism may lead to the development of more efficacious treatments for ADHD with reduced or absent untoward side effects.



BRIANA CARROLL

Chicago, Illinois

Honors Advisor: Catherine McCormick

Investigation of the Lateral Line Organs in the Hatchetfish

The goal of my project is to determine the nature of the sensory input to a brain circuit unique to the freshwater hatchetfish. My study continues an investigation of the lateral line system of freshwater hatchetfish initiated by Jessica Hauser (2005). The lateral line system in fish is comprised of modified hair cell receptors in the epithelium, including mechanoreceptors which sense water movement, and electroreceptors which sense electrical currents. Mechanoreception is present among all teleosts and generally precedes development of electroreception.

Hauser's research employed the silver and marbled hatchetfish, *Gasteropelecus sternica* and *Carnegiella strigata*, and was based on Mark Braford's discovery of an unidentified nucleus (EX) proximate to the first-order mechanosensory lateral line nucleus of the hatchetfish medulla. EX resembles the electrosensory lateral line lobe (ELLL), which receives input from electroreceptors and is found among those teleosts that have developed electroreception. Hauser found that, like the ELLL, the EX receives input from the anterior and posterior lateral line nerves and projects to a distinct region of the torus semicircularis. However, she was unable to demonstrate the total connection retrogradely, and did not identify the sensory organ that provides input to EX. These are questions my research will address.

In order to demonstrate the retrograde connection between EX and the torus in vitro, I will inject a neurobiotin solution into the area of the torus identified as the EX target. This stain will perfuse the tract and allow me to visualize and confirm the pathway between EX and the torus. To find candidate organs that may provide input to EX, I will prepare slides for a histological analysis of the epithelium by decalcifying a whole fish, embedding it in paraffin, slicing it on a microtome, and staining the sections with cresyl violet.



ANNA FRACKMAN
Madison, Wisconsin

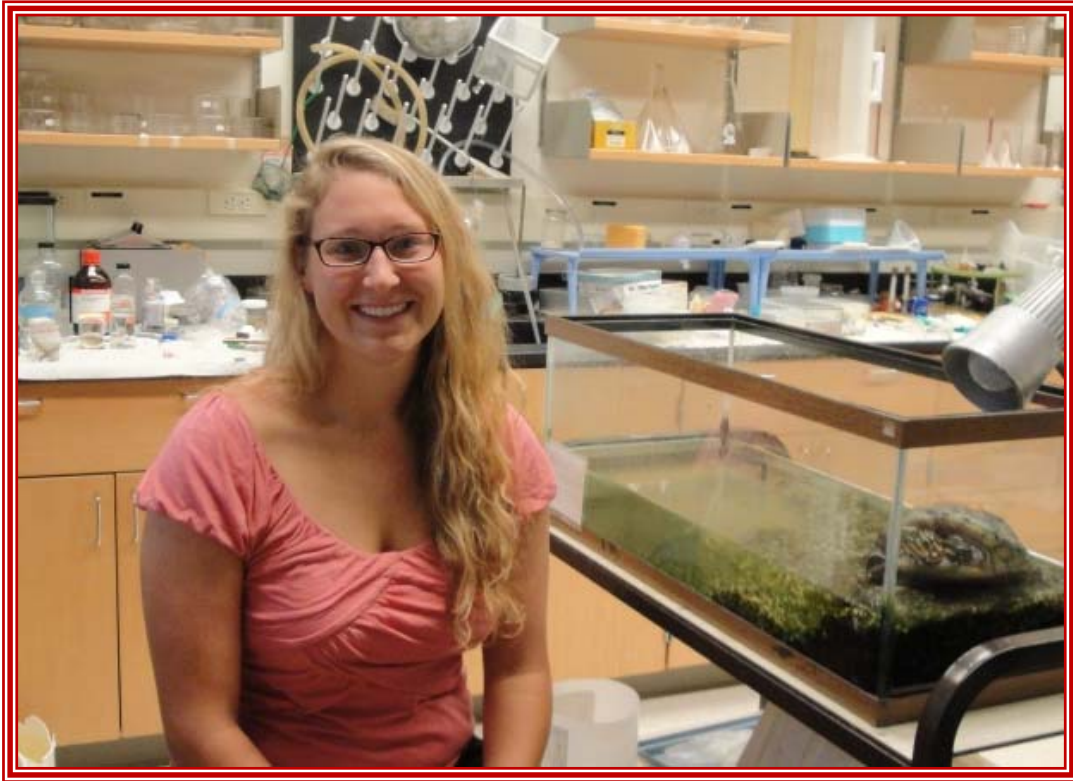
Honors Advisor: Tracie Paine

Role of DA in the PFC in Risk vs. Reward Decision Making

Many neuropsychological conditions including drug addiction, ADHD and problem gambling are characterized by poor decision-making. Decision-making consists of several discrete but related components including impulsive choice and risk-taking behavior. Currently, the biological basis for disadvantageous decision-making is widely studied but not completely understood.

The prefrontal cortex (PFC), a portion of the frontal lobes, is located at the rostral end of the brain, and is generally thought to be involved in “central executive functions,” or higher cognitive functions such as decision making, working memory, and integration of information. Dopamine, specifically within the prefrontal cortex, has also been shown to play a role in decision-making and impulse control.

For my honors project, I am studying the role of PFC dopamine in complex risk vs. reward decision-making using a rat version of the Iowa Gambling Task. This task involves the rat choosing from one of four options, each of which is associated with a different reward and punishment. The two advantageous choices result in immediate delivery of a single food reward and the chance of a relatively short (6-12 s) punishment period. Punishment periods delay the start of the subsequent trial thereby delaying the opportunity for the animal to win more food rewards. In the two disadvantageous choices result in immediate delivery of 2 food rewards and the chance of a much longer (222-444 s) punishment period. In this paradigm, like in the human model, consistently advantageous choices over the long term will result in more net gain than negative choices. For my project, I will be testing the effects of intra-PFC infusions of the D1 receptor antagonist SCH23390 on risk-reward decision-making. Based on results of studying similar DA modulators on a variety of related tasks such as T-maze tests and the 5CSRTT, we expect to see that inducing lower levels of cortical D1 receptor activation using the D1 antagonist SCH23390 will result in poorer performance on the rGT.



MARISSA KAMARCK
Media, Pennsylvania

Honors Advisor: Mark Braford

**Why Size Matters: Comparison of Telencephalic Cell Groups
Amongst Coral Reef Acanthomorphs with Enlarged Telencephala**

Behavioral studies have shown that fish create an internal representation of their environment as a means to find food and evade predation. The internal map can be created through vision, lateral line sense, or electroreception. In general, coral reef fish have larger telencephala, probably due to the complexity of their environment, which requires a more complex internal map. Three orders of the coral reef teleosts have the most enlarged telencephala: Beryciformes, Perciformes, and Tetraodontiformes. My goal is to study the telencephalon of a representative species from each of these three orders to see if the telencephalon has enlarged as a whole or if particular cell groups have enlarged relative to the rest of the telencephalon. If the latter is the case, I will attempt to determine if special sensory or behavioral characteristic correlate with the enlarged cell groups.



ABBY LAMAN-MAHARG

State College, Pennsylvania

Honors Advisor: Jan Thornton

Determining where luteinizing hormone (LH) is acting to affect spatial memory performance of ovariectomized rats

Alzheimer's Disease is a degenerative brain disorder characterized by continuing declines in memory, thinking, comprehension, calculation, language, learning capacity, and judgment. Deficits in spatial memory have been regarded as an early indication of AD and are generally thought to be due to neuron degeneration in the hippocampus. Luteinizing hormone (LH) may play an important role in cognitive function. High levels of LH have been shown to decrease spatial memory in ovariectomized rats. Based on previous research showing a high density of LH receptors in the hippocampus as well as deficits in spatial memory caused by hippocampal damage, it is likely that LH is acting on receptors in the hippocampus to affect spatial memory. However, there has been no research done to show this definitively. The current study will determine if LH is acting in the brain to affect spatial memory, and, if so, where in the brain LH is acting. Likely areas include the dorsal and ventral hippocampus and the prefrontal cortex.



CLAIRE MCGREGOR

Chicago, Illinois

Honors Advisor: Jan Thornton

Estrogen and Cognitive Deficits in a Rodent Schizophrenia Model

Schizophrenia is a psychiatric disease consisting of positive symptoms, negative symptoms, and cognitive deficits. There is evidence that estrogen can help ameliorate some of these symptoms in female schizophrenia patients. Phencyclidine (PCP) is an NMDA receptor channel blocker which when given to rodents has been shown to model many of the symptoms of schizophrenia. Effects are persistent after PCP has left the rat's system, which led a theory of schizophrenia based on NMDA receptor hypofunction.

In our lab, previous research has shown that estrogen can help ameliorate the cognitive deficits caused by PCP in the novel object recognition test (NORT). We are now looking to find which receptors estrogen is working through to ameliorate these effects using agonist and antagonist studies aimed at NMDA receptors.



ELIZA MILNER
State College, Pennsylvania

**Honors Advisors: Roberto Fernández Galán – Case Western Reserve
Catherine McCormick**

Linking Structure and Function Through Analysis Of Complexity And Dynamics In Neural Networks

My project, designed via the Galan lab at Case Western Reserve University, concerns the application of mathematical measures of complexity to neural networks. Its main aim is to determine features of anatomical connectivity that lead to high neural complexity in a network. Once complexity is calculated, we can potentially use related tools to analyze the functional connectivity of these artificial networks and examine the components and dominant modes of their activity in novel ways, possibly connecting this dynamical behavior to the complexity of the system and to the presence of different anatomical motifs.

Neural complexity is a measure from information theory that is related to the mutual information shared between components of a network. It reflects the change in uncertainty in one random variable in a system given the knowledge of others; or, it can be conceived of as how closely the joint distribution of those variables matches an independent joint distribution. Complex systems are usually made up of smaller individual units (in this case, individual neurons or nodes) that engage in relatively simple local behavior and contain multiple levels of organization, generating emergent behavior at higher levels. Systems that are highly complex tend to be balanced between random and highly ordered behavior.

I am generating families of representative connectivity matrices by convolving an unweighted adjacency matrix with a connectivity kernel modeled using a Gabor function. The two parameters of this kernel I am changing roughly map to connection weight periodicity and cortical column width. I will be testing the relationship between these parameters and the complexity of the resultant networks. If there is sufficient published anatomical data, I will also explore other known patterns of local connectivity in cortical columns in the visual cortices of several different mammals (interpreting them as kernels) and the way that those features translate into mathematical complexity. Since measuring the complexity of a neural network requires knowledge of its activity patterns and not just its anatomical structure, I will be modeling the networks as dynamical systems using a (nonlinear) Wilson-Cowan model. I plan to use this implementation to calculate complexity and also potentially study different aspects of their functional connectivity, such as principal and independent components of the network activity, in response to biologically accurate input and random noise.

The link between anatomical connectivity and complexity/functional dynamics is interesting because research in this vein may eventually provide us with the tools to reverse-engineer the structure of a network from its local activity. A cross-species comparative study of complexity and its relation to connectivity features of a network might also give us insight into the evolutionary conservation of certain anatomical motifs.



ALLISON RICHARDS

Lambertville, New Jersey

Honors Advisor: Katie Caldwell

Several lines of evidence suggest that serotonin_{2c} (5-HT_{2c}) receptors play a role in anxiety. Specifically, 5-HT_{2c} receptor knockout mice are known to exhibit reduced levels of anxiety. Likewise, 5-HT_{2c} receptor antagonists and inverse agonists possess anxiolytic-like properties in animal models of anxiety, while 5-HT_{2c} receptor agonists are anxiogenic. This study examined the effects of 5-HT_{2c} receptor agonism on anxiety in two strains of male mice, inbred for activity levels in an open field (DeFries mice). The two strains of DeFries mice used are identified as H mice, named for their High levels of activity in an open field, and L mice, named for their Low levels of activity in an open field.

We have replicated a significant difference in baseline anxiety between the two strains of mice in an elevated plus maze, as measured by number of entries into the open arms and the time spent in the open arms. We then found that administration of the 5-HT_{2c} receptor agonist meta-Chlorophenylpiperazine (mCPP, 2 mg/kg i.p.) significantly decreased the number of entries into the open arms and the time spent in the open arms in the (over-anxious) L mice, and significantly decreased the time spent in the open arms in the (under-anxious) H mice. Interestingly, the effect of the agonist is significantly larger on the over-anxious strain for both measures, suggesting that these mice have a potentiated response to 5-HT_{2c} receptor ligands. Perhaps one of the genetic differences that resulted from inbreeding the two strains is related to 5-HT_{2c} receptor expression and/or function.

While genetic mapping studies have revealed quantitative trait loci for the two strains of DeFries mice, the molecular mechanisms underlying the behavioral differences remain unknown. Continuing studies will examine the effects of 5-HT_{2c} receptor inverse agonism on the two strains of mice. It is expected that the inverse agonist will decrease anxiety in both strains of mice and that this effect will be potentiated in the (over-anxious) L mice, due to their hypothesized overexpression and/or hyperfunction of 5-HT_{2c} receptors. These data have implications for understanding the complicated pathology that underlies anxiety disorders and for the development of novel therapeutics.



JONATHAN WACHTEL
Scarsdale, New York

Honors Advisor: Tracie Paine

The Roles of Discrete Environmental Drug-Associated Cues and Cue-Induced Impulsivity on Relapse in a Rodent Model of Cocaine Addiction

Cocaine is one of the most highly used stimulant drugs of abuse. Problematically, cocaine addicts exhibit a high propensity to relapse, the resumption of drug taking after a period of abstinence. There exist numerous triggers for cocaine relapse, including exposure to drug-associated cues, stress, and re-exposure to the drug itself. In humans, these triggers are thought to induce craving, the intense desire for previously experienced drug effects, which precipitates relapse. Alternatively, relapse may be considered an impulsive act, whereby addicts are unable to inhibit the pre-potent drug-taking response.

The goal of my thesis is to determine whether discrete environmental drug-associated cues can lead to changes in impulsive behavior. First, I will establish the parameters necessary for successful Pavlovian conditioning between intraperitoneal (IP) cocaine administration (15 mg/kg) and a discrete environmental cue (compound cue consisting of both auditory and visual stimuli). I will also examine whether we observe an "incubation effect," increased cue-induced locomotor activity following protracted withdrawal as compared to early withdrawal. After establishing parameters for successful Pavlovian conditioning, I will determine whether exposure to drug-associated cues will increase impulsive behavior in the 5-choice Serial Reaction Time Task (5CSRTT).

If drug-associated cues increase impulsive behavior, this could have profound implications for the treatment of drug addiction and relapse. First, such results would suggest that abstinent cocaine addicts are prone to relapse due to cue-induced impulsivity rather than, or in addition to, cue-induced drug craving. Second, such results would suggest that current treatments for impulsive behavior might be efficacious as novel treatments for cocaine addiction.



NATHAN HARRIS

Easton, Pennsylvania

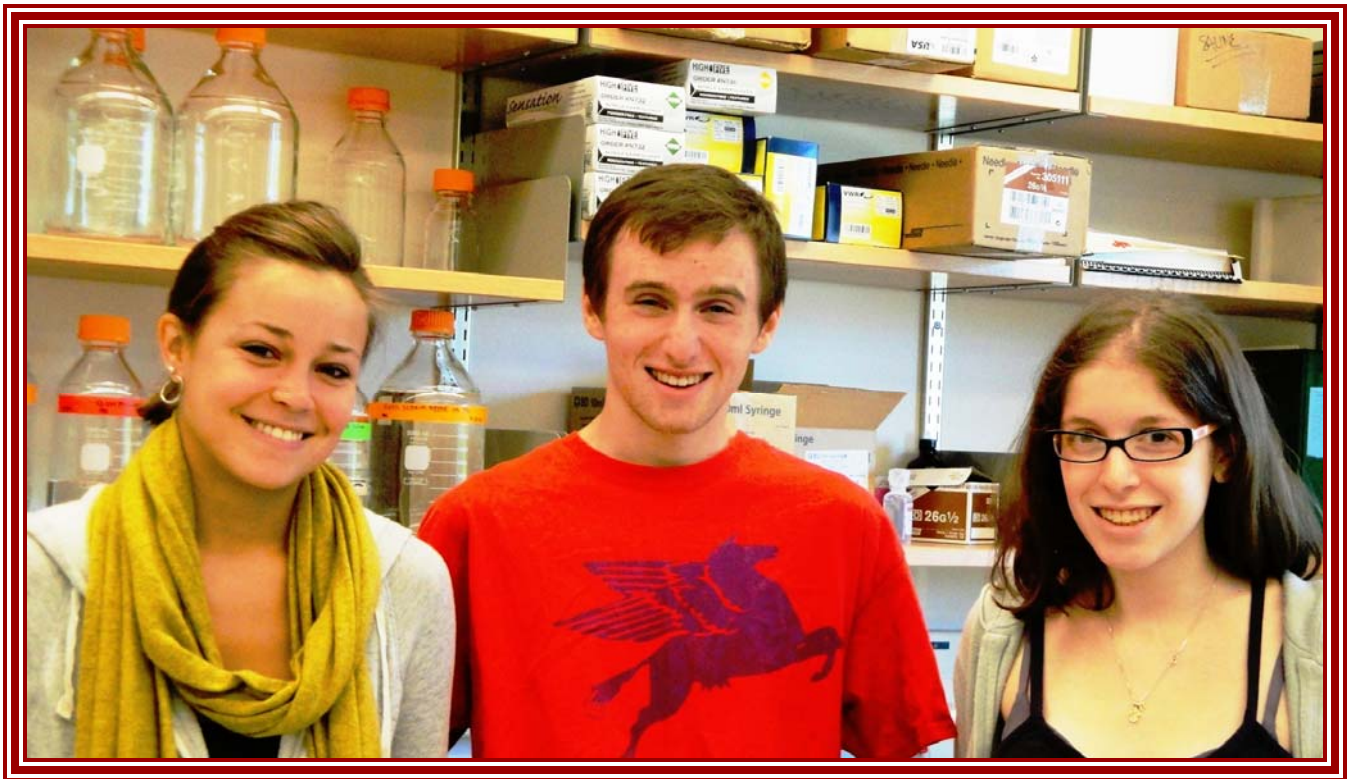
Research Advisor: Brian Woodside

The Effect of MDMA Induced Serotonergic Neurotoxicity on Long-term Potentiation *in vivo*

MDMA - “ecstasy” is a popular drug of abuse in the United States, particularly among young adults. In rodent studies simulating “binge” use by humans (a couple of weekends of high use), MDMA administration was found to be neurotoxic to the serotonin system in many brain areas, including the hippocampus. Similar MDMA regimens impair spatial learning and memory in rodents. Studies of human MDMA abusers are more difficult to interpret because of polydrug use, but there is evidence for memory impairment.

Long-term potentiation (LTP), a phenomenon by which synaptic connections are strengthened in an activity-dependent fashion, is likely an underlying mechanism of learning and memory. Because hippocampal LTP is important for memory, and because MDMA use causes both neurotoxicity of the hippocampus and memory impairment, changes in LTP may play a role in memory impairments associated with MDMA induced neurotoxicity.

In order to observe these changes, I will administer MDMA to rats in doses simulating “binge” use by humans, wait at least two weeks to allow for serotonergic neurotoxicity, and record long-term potentiation from hippocampal area CA1 *in vivo*. I will then confirm serotonergic neurotoxicity of the hippocampus either by high-pressure liquid chromatography or immunohistochemistry. Based on previous studies on LTP during manipulation of the serotonin system, I expect MDMA induced serotonergic neurotoxicity to enhance LTP.



Cassie Burley, Montpelier, VT, Sam Asinof, Providence, RI, Abigail Lofchie, New York, NY

Research Advisor: Tracie Paine

Neuropharmacology Research Experience

Student researchers in the Paine Lab are working with Neuroscience Honors students on a variety of ongoing projects investigating the biological basis of cognitive functions such as impulse control, decision-making and attention. As part of their experience, they are learning behavioral testing techniques (5-choice serial reaction time task, rat gambling task, Pavlovian conditioning), histological techniques (brain tissue sectioning, cresyl violet staining) and molecular biological techniques (immunohistochemistry). In addition, student researchers are learning techniques to deliver drugs systemically or centrally.



NORA HAMMACK

San Francisco, California



SCARLET WOODRICK

Ann Arbor, Michigan

Research Advisor: Katie Caldwell

Localization of the Serotonin 5-HT_{2c} Receptor Within the Rat Striatum

5-Hydroxytryptamine (5-HT, or serotonin) is a neuromodulator that acts all over the brain to regulate a diverse set of neural processes. One pathway in which serotonin is known to play a modulatory role is within the dopamine (DA) system, particularly the DA pathway projecting from the substantia nigra pars compacta (SNpc) to the striatum. The nigrostriatal DA pathway is very important in the production of movement, and degeneration of these neurons causes the motor deficits seen in Parkinson's Disease.

Microdialysis studies show that specifically within the striatum serotonin modulates the release of DA by neurons projecting from the SNpc. One particular subtype of the serotonin receptor, 5-HT_{2c}, is known to be responsible for this 5-HT action. While it is known that the 5-HT and DA pathways converge within the striatum, the circuitry underlying this interaction is yet unknown. We are hoping to figure out what type of cell in the striatum holds these 5-HT_{2c} serotonin receptors. Evidence suggests that the receptors are likely located on GABA-ergic interneurons, and we will investigate this hypothesis using immunohistochemical approaches attempting to colocalize the 5-HT_{2c} receptor with a specific marker for GABA-ergic interneurons within the rat striatum.



MATT HARTSOCK

Williamsport, Pennsylvania



JOSH BALLARD

Wellington, Ohio

Research Advisor: Mark Braford

Connections of the Amygdala in Goldfish

Matt Hartsock: The amygdala has traditionally been considered to be a unitary brain structure that plays an important role in emotional behavior. Recent research, however, suggests that the amygdala is not a unitary structure and, in reality, consists of diverse cell groups that differ significantly in their origins, connections and functions. Through a series of tract-tracing studies in goldfish, I will examine the neural projections to and from the supracommissural nucleus of the area ventralis (a subpallial region that has been compared to part of the amygdala). My hypothesis is that this nucleus in goldfish is homologous to the central nucleus of the amygdala in other vertebrates. My hypothesis will be strongly supported if I find projections from this nucleus to the lateral hypothalamus and to the brainstem.

Josh Ballard joined the Braford Lab for Winter Term 2011 and Spring, 2011, assisting Matt with his research on the connections of the amygdala in goldfish.



GABRIELLE BROMBERG

New York, New York

Research Advisor: Jan Thornton

Neuroendocrine Research

I will be observing and participating in a variety of neuroendocrine research techniques including surgery, cannula implantation, behavioral testing and data analysis.



JAY MEJIA

Beaumont, Texas

Research Advisor: Jan Thornton

**Localization of the Effects of
Luteinizing Hormone (LH) in the Brain**

High levels of LH suppress spatial memory in female rats. Recently we have been administering LH to specific brain regions to determine where within the brain it exerts its actions.



LINDSAY BOVEN
Park Ridge, Illinois

Research Advisor: Tracie Paine

Neuropharmacology Research Experience

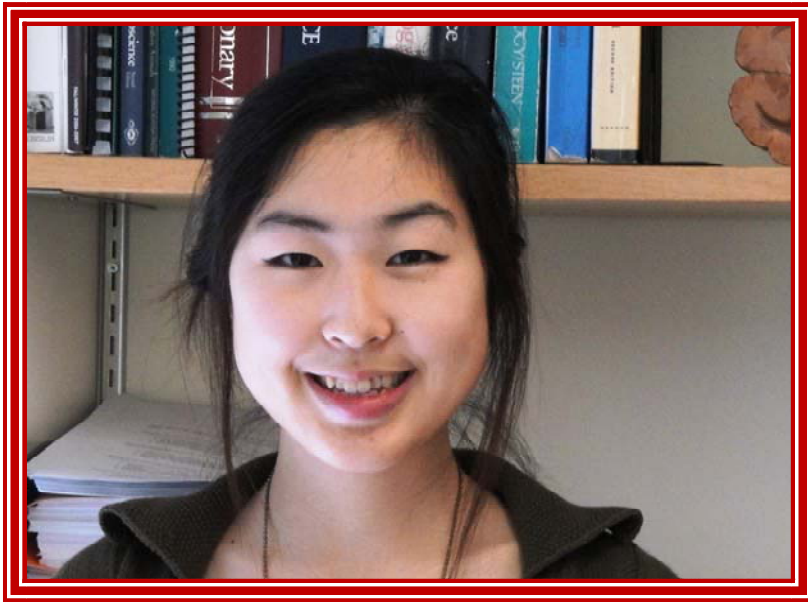
Spring semester, Lindsay joins student researchers in the Paine Lab who are working with Neuroscience Honors students on a variety of ongoing projects investigating the biological basis of cognitive functions such as impulse control, decision-making and attention. As part of the experience, they are learning behavioral testing techniques (5-choice serial reaction time task, rat gambling task, Pavlovian conditioning), histological techniques (brain tissue sectioning, cresyl violet staining) and molecular biological techniques (immunohistochemistry). In addition, student researchers are learning techniques to deliver drugs systemically or centrally.



CORA ALLEN-COLEMAN
Madison, Wisconsin

Research Advisor: Katie Caldwell

Cora has joined the Caldwell Lab this spring and is working with Neuroscience Honors student, Allison Richards, on her project dealing with serotonin_{2c} (5-HT_{2c}) receptors.



SEUNG YUN JEE
Republic of Korea

Research Advisor: Mark Braford

Seung Yun Jee joined the Braford Lab during Winter Term, 2011, working with Marissa Kamarck: “Why size matters – Comparison of Telencephalic cell groups amongst coral reef acanthomorphs with enlarged telencephala.” She is continuing on this research project through Spring, 2011.



ATHREYA TATA
McLean, Virginia

Research Advisor: Mark Braford

Athreya Tata began a new research project: “Intrinsic and extrinsic connections of the dorsolateral telencephalon in the African knifefish, *Xenomystus nigri*, Spring, 2011.



ALIA SYED
Oakland, California



JOE LEFFLER
Norwalk, Ohio

Research Advisor: Mark Braford

Caloric Restriction and Neurogenesis in Teleost Fish

Alia Syed: Caloric restriction has been linked to increased longevity in many animal species (including teleost fish) and to increased neurogenesis (birth of new neurons) in some species. However, there has not been a study that has looked at the effects of dietary restriction on neurogenesis in fish so in this project we will examine whether caloric restriction in zebra fish increases neurogenesis in the telencephalon. To test this hypothesis we will restrict the diets of the fish for four weeks, after which we will react the fixed brains with an antibody against PCNA (proliferating cell nuclear antigen) which is present in dividing progenitor cells. If caloric restriction in zebrafish does increase neurogenesis we would expect to see more antibody binding in the calorically restricted fish compared to controls.

Joe Leffler joined the Braford Lab, working with Alia over Winter Term and continuing through the spring semester.



ZOE KLAR
Yonkers, New York



NATHAN MICHAELSON
Chicago, Illinois

WINTER TERM 2011

Research Advisor: Tracie Paine

Neuropharmacology Research Experience

Research Advisor: Katie Caldwell

Localization of the Serotonin 5-HT_{2c}
Receptor Within the Rat Striatum



SAGE ARONSON
Guilford, Connecticut



TRISHUL MEHTA
Bullard, Texas



ALEX AMLIE-WOLF
Ardmore, Pennsylvania

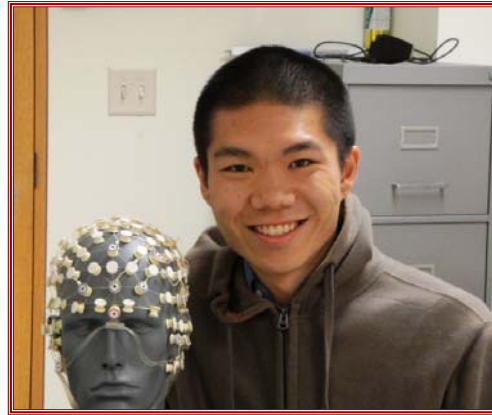
Research Advisor: Michael Loose

I think it will, I think it will: Factors influencing difficult predictions

Previous experiences and previous outcomes affect one's predictions of future events. An interaction of conscious and unconscious processes can contribute to the final choice of what to predict. For example, when gambling one may get the feeling that a particular outcome is likely. What contributes to such hunches and how does the brain create them? Using EEG recordings we will examine the nature of the predictions, and the neural correlates of these predictions, made in the presence of incomplete information and following varying reward outcomes.



HANNAH SCOTT
Cleveland, Ohio



ANREY WANG
Los Angeles, California



KRISSY WELCH
Flint, Michigan

Research Advisor: Michael Loose

Handicapping Horses: Balancing Expectation and Conflicting Information

Deciding which of two possible objects has appeared is affected by one's expectation of what is likely to appear and by the nature of the visual stimulus. If the stimulus has characteristics of both possible objects one influential theory is that certain neurons/circuits in the brain contribute to deciding if one of the objects has appeared and a different set of neurons/circuits are assigned to deciding if the other object has appeared. The so-called race theory posits that the two sets of neurons both increase their activity in a race to reach a threshold value and the winner of the race results in a perceptual decision that the object those neurons represent is perceived. There are several interesting parameters in such a model, the starting points in the race, the rates of rise, and the levels of the threshold are three such parameters. We will test the hypothesis that a higher expectation that one of the two objects will appear can bias the starting points in this race to threshold. Expectations will be modified by altering actual probabilities and EEG recordings and behavioral responses will be measured.



GEOFF DIEHL
Watertown, Massachusetts



ELI GOSHORN
Hopewell, New Jersey



JONATHAN MEJIA
Beaumont, Texas



TEDDY PALLIS
Piedmont, California



MIKE RAUSCHER
Export, Pennsylvania



CHINWE OKONA
Coral Springs, Florida

Verapamil and Long-term Memory - Research Advisor: Brian Woodside

This group of students is studying the role of the L-type voltage-dependent calcium channel (VDCC) on learning and memory. Long-term potentiation (LTP) is a cellular mechanism believed to underlie certain forms of learning and memory. There are two forms of LTP in the CA1 region of the hippocampus, a temporal lobe brain structure that plays an important role in episodic memory formation. One form is mediated by N-methyl-D-aspartate receptor/channels and lasts for hours to days and may be responsible for temporary learning and shorter periods of retention. The other form of LTP is mediated by calcium influx through VDCCs. Calcium influx through these channels can cause early gene expression and lasting physical changes to the cell possibly promoting long-term memory storage.

Verapamil is a drug that blocks L-type voltage-dependent calcium channels. In these research experiments with rats we are looking first at whether verapamil will impair memory for novel objects over either a brief retention period, 1 ½ - 2 hours, or a longer period, 24 hours. In the spring semester we will be examining directly the effect that verapamil has on individual cells in the hippocampus by using electrodes to listen to the firing activity of individual neurons as they learn and encode where the animal is in a new environment.

Many older adults suffer from learning and memory impairments that are attributed to either "old age" or forms of mild dementia. Some of these people are taking verapamil to treat cardiovascular problems. It is our hope to contribute to the ongoing research on medications such as these that could be responsible for a misdiagnosis in the area of learning and memory.



ADRIANA AKINTOBE
Atlanta, Georgia



SIÉN RIVERA
El Cerrito, California



BEN SULLIVAN
Sarasota Springs, New York

Research Advisor: Brian Woodside

Can Practice Make Perfect: a Study in Human LTP

Long-term potentiation (LTP) is an enduring change in synaptic strength believed to underlie certain forms of learning and memory. It is specific to specific areas of the brain involved with learning and memory and is enhanced by repetitive activity. Using animals as research subjects different forms of LTP have been discovered in many areas of the brain and spinal cord. Recently research has been done on human subjects by recording LTP from areas of cortex close to the scalp using electroencephalograms (EEGs). LTP has been found in the occipital cortical areas and in the auditory and somatosensory areas using flashing lights, repeated tones or electrical stimulation of the nerves in the wrist. However, everything so far has been done with only passive participation by the individual subject, and no work has been done to discover is LTP occurs naturally from subject initiated practice.

In this research project we will have the subjects practice musical performance and measure LTP in the motor, supplementary motor, pre-motor, somatosensory, and auditory cortical areas. It is our hypothesis that these areas will demonstrate some short and some enduring forms of LTP, and that the LTP found in these areas will either be synchronous or consecutive in timing order depending on the areas compared.

Alex Amilie-Wolf is also participating in this project, not pictured.