### EXAMPLES OF STUDENT RESEARCH PROJECTS AT OBERLIN

**ACADEMIC YEARS 1995 to Present**

(H = Honors; R = Research; WT = Winter Term Project; Rsst = Research Assistant)

(MacGregor-Oresmon = MO; Howard Hughes = HH; McNair = MN; NSF = National Science Foundation; G-in-A = Grant-in-Aid)

#### Spring 2014

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<td>Adelman, Julia</td>
<td>a project that is designed to study the hippocampal memory system; a network of brain regions that are essential for everyday events</td>
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<td>Aligbe, Eni</td>
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<td>O’Hara, Avery</td>
<td>how the GABA interneuron system (specifically GABAa receptors) in the dorsal lateral prefrontal cortex (DLPFC) relate to decision-making</td>
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#### Winter 2014

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<td>Title: Don’t Forget the Cerebellum: Visualizing Connections within the Motor System.</td>
<td>Research</td>
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<td>Bell, Christopher</td>
<td>The goal of my current Winter Term project is to create a descriptive model of the male hypothalamic-pituitary-gonadal (HPG) axis as an emergent system. Using methods learned from Professor Downing’s course, I have explained the male HPG</td>
<td>Research</td>
<td>K. Downing</td>
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<td>Bohm-Levine, Nate</td>
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Previous studies have shown that individuals with Autism Spectrum Disorders (ASD) have extended hormone on cognitive functioning in animal models of HD. The effects of estrogen on recovery of brain function in an animal model of schizophrenia have been studied. Specifically, environmental factors may modulate the age of disease onset, triggers and exacerbate HD symptoms and neuropathology. Monozygotic twin studies, as well as experimental cognitive and psychiatric abnormalities. However, emerging evidence from epidemiological and cortical GABA transmission affects cognitive behavior. As part of their experience, they learned histological techniques (brain tissue sectioning, cresyl violet staining), molecular biological techniques (immunohistochemistry) and how to deliver drugs through different systemic routes of administration.

This winter term Jarrett and Ted gained Neuropharmacology research experience by working on a variety of projects aimed at understanding the manner in which cortical GABA transmission affects cognitive behavior. As part of their experience, they learned histological techniques (brain tissue sectioning, cresyl violet staining), molecular biological techniques (immunohistochemistry) and how to deliver drugs through different systemic routes of administration.

Il studied memetics and cultural information transmission, analyzing the complexity found in the spread of ideas. Memes, or units of culture, travel and grow in observable patterns. We were looking at complex/emergent systems that arise from local interactions of unintelligent/simple actors. My particular research was into Artificial Immune Systems, and how the traits the body uses to select lymphocytes can be applied to optimization and categorization problems in mathematics.

Gaining expertise in neuroendocrine techniques such as brain sectioning and immunocytochemistry and how fluorescent detection of amygdalar and prefrontal cortical pathways in the rat brain. Studies on the effect of a luteinizing hormone antagonist infused into the hippocampus on spatial memory in rats. Effects of estrogen on GABA synthesis in an animal model of schizophrenia.

Specifically, I worked with elementary CA's, stochastic CA's, and continuous state CA's. 

Neuroendocrine Research.

Neuroendocrine Research.
temporal windows of integration. It is also known that people with ASD have attention deficits. Our research is examining how attention impacts audio-visual multisensory integration. Our lab recently is completing research on event-related potential waveforms that predict future choices in a task where individuals are freely choosing which of two options will occur.

**Berman, Alec**  
Research  
**Loose**

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**Blackwell, Marissa**  
The primary aim of our research is to better understand how attention influences a person’s ability to integrate information across multiple sensory modalities (multisensory integration). Previous research in the Kwakye lab has shown integration of audiovisual stimuli to be affected by a concurrent secondary sensory task.

**Research**  
**L. Kwakye**

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**Cooke, Elizabeth**  
Neuropsychology Research Experience  
Student researchers in the Paine Lab are working on a variety of projects assessing the “GABA hypothesis of schizophrenia”. GABAergic dysfunction is disrupted in the prefrontal cortex of people with schizophrenia; changes in GABA function may contribute to the cognitive deficits observed in schizophrenia.

**Research**  
**Paine**

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**Dean, Cassandra**  
Multisensory integration is the process by which information from different sensory systems is processed and integrated in the brain. Accurate integration from different sensory modalities is essential for everyday functioning and lives. Past studies have shown that individual’s with Autism Spectrum Disorder (ASD) have difficulty integrating multisensory information and have uncovered a possible genetic connection between sensory perception and ASD.

**Research**  
**G. Kwakye**

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**Eggeston, Brady**  
Gaining expertise in neuroendocrine techniques such as brain sectioning and immunocytochemistry and using those techniques in research projects that are examining the effects of estrogens and Luteinizing Hormone on cognitive functioning in animal models of schizophrenia and Alzheimer's disease.

**Research**  
**L. Kwakye**

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**Freeman, Jason**  
Title: Modeling people’s choices when they are predicting speed making: Predicting speed and accuracy tradeoff and reward rate optimization  
Our project is to investigate the neurotoxic effects of solvents in Huntington’s disease (HD) neuropathology. HD is a genetic neurological disorder characterized by loss of neurons in the striatum. Indeed, the environment has been suggested to modify cellular mechanisms implicated in the disease to induce phenotype changes in HD patients and animal models. However, this identity of the environmental modulator(s) is yet to be identified. We seek to identify the major environmental modulator(s) and its neurotoxic effects on cellular mechanisms implicated in HD neuropathology.

**Research**  
**G. Kwakye**

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**Jackson, Maya**  
My research project is to investigate the neurotoxic effects of solvents in Huntington’s disease (HD) neuropathology. HD is a genetic neurological disorder characterized by loss of neurons in the striatum. Indeed, the environment has been suggested to modify cellular mechanisms implicated in the disease to induce phenotype changes in HD patients and animal models. However, this identity of the environmental modulator(s) is yet to be identified. We seek to identify the major environmental modulator(s) and its neurotoxic effects on cellular mechanisms implicated in HD neuropathology.

**Research**  
**Paine**

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**Martorella, Molly**  
Gaining expertise in neuroendocrine techniques such as brain sectioning and immunocytochemistry and using those techniques in research projects that are examining the effects of estrogens and Luteinizing Hormone on cognitive functioning in animal models of schizophrenia and Alzheimer's disease.

**Research**  
**Thorton**

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**Marx, Gabe**  
My work is focused on connectivity analysis of fMRI data. In particular I am interested in applying the Dynamic Causal Modeling (DCM) technique to investigate how well theoretical models of functional connectivity fit MRI data. This past summer, I worked with fMRI data recorded during a two-choice decision-making task. Using DCM, I investigated how well the neural diffusion model (NDM) fit the observed functional connectivity from the fMRI data of this task. The NDM is an artificial neural network that is based on the drift diffusion model—a hallmark tool used to investigate different components of decision making processes popular in both the cognitive psychology and cognitive neuroscience community.

**Research**  
**Simen**

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**McDonald, Kaetlyn**  
Many studies have examined the interaction between attention and multisensory integration in adults, but much less is known about how this complex relationship develops during childhood. The goal of our research is to investigate the development of multisensory attention in children. Using neurotypical children between ages 4 and 17, we will compare the effects of endogenous and exogenous spatial shifts in attention on a crossmodal orthogonal attentional cuing task.

**Research**  
**L. Kwakye**

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**O'Hara, Avery**  
Cognitive deficits are one of the core features of schizophrenia, and one central cognitive deficit seen in individuals with schizophrenia is impaired decision-making. Impaired decision-making manifest from dysfunctions in multiple neurotransmitter systems, such as the inhibitory neurotransmitter GABA and modulatory neurotransmitter dopamine. My project will focus on how the GABA interneuron system (specifically GABAa receptors) in the dorsal lateral prefrontal cortex (DLFFC) relate to decision-making.

**Research**  
**Paine**

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**Owen, Matt**  
Gaining expertise in neuroendocrine techniques such as brain sectioning and immunocytochemistry and using those techniques in research projects that are examining the effects of estrogens and Luteinizing Hormone on cognitive functioning in animal models of schizophrenia and Alzheimer's disease.

**Research**  
**Thornton**

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**Papadakis, Samantha**  
The Drift Diffusion Model (DDM) mathematically simulates how people make two-choice decisions as a process of evidence accumulation up to a threshold level of evidence to trigger a response. I used a DDM to simulate decision reaction time data using various combinations of DDM parameters. By varying the drift (rate of evidence accumulation) across trials while holding the threshold constant, I found that the micro speed-accuracy tradeoff (mSAT) curve sometimes decreases over time, meaning that slower responses are less accurate than faster ones.

**Research**  
**Simen**

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**Parel, Gian**  
Two-alternative decision-making: Predicting speed-accuracy tradeoff and reward rate optimization  
The drift diffusion model (DDM) simulates and predicts speed-accuracy tradeoff and reward rate optimization behavior in two-alternative forced-choice (2AFC) decision-making tasks similar to behavioral

**Research**  
**Simen**
Petit, Arjuna
Research
L. Kwakye

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L. Kwakye

Wittenberg, Ruthie
Title: Searching for Event-Related Potential waveforms that predict future choices in a task where individuals are freely choosing which of two options will occur.
Research
Loose

Daneshvar, Hannah
Investigation of the effects of methoxychlor and its metabolites on striatal medium spiny neurons expressing wild-type and mutant Huntington genes
Research
G. Kwakye

Freedman, Jason
A quantitative evaluation of the factors that result in the probability matching phenomenon: Using and interpreting an Artificial Neural Network (ANN)
Research
Loose

Eni Aligbe
The intricate relationship between multisensory integration and attention has been thoroughly researched in the multisensory field; however, the necessity of attention for the binding of multisensory stimuli remains unclear. In a previous study, we investigated whether diverting attention from a well-known multisensory speech task would disrupt integration.
Research
L. Kwakye

Cooke, Elizabeth
Role of prefrontal cortex GABA function in cognition Schizophrenia is characterized by cognitive impairments that are not adequately treated by currently available medications and may contribute to the poor outcomes of afflicted individuals. Evidence from post-mortem analyses suggests that inhibitory γ-aminobutyric acid (GABA) neurons are dysfunctional within the prefrontal cortex of people with schizophrenia. The prefrontal cortex is critical for optimal cognitive functioning, thus neuropsychology within this brain area may contribute to cognitive deficits observed in schizophrenia.
Research
Paine

Potterfield, Jeremy
My name is Jeremy Potterfield and I am a senior neuroscience major. My work in Professor Leslie Kwakye’s sensory neuroscience lab involves using a virtual reality environment to evaluate the way in which humans perceive sensory stimuli. The use of a virtual reality environment allows our lab to simulate for our participants the kind of multisensory cues that humans experience in everyday life while simultaneously evaluating their sensory abilities.
Research
L. Kwakye

Riordan, Alex
Research
Simen

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Russ, Susan
Recent work shows that multisensory integration (such as seeing and hearing the same object) may be modulated by experience. For example, musicians display a distinct pattern of audiovisual integration when compared to non-musicians.
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Schizophrenia affected roughly 24 million people in 2011, yet treatments for neurological symptoms are often inadequate and poorly understood. One hypothesis is that the hindered capacity of the adult brain to undergo neurogenesis may play a role in producing schizophrenic symptoms. During this past summer, we investigated the subchronic Phencyclidine (PCP) animal model of schizophrenia, a model that accurately produces long-term schizophrenia-like symptoms.

Huntington’s Disease (HD) is an autosomal dominant, neurodegenerative disorder characterized by a triad of symptoms: cognitive, psychiatric, and motor. The genetic mutation in the Huntington gene (Htt) results in an expanded polyQ tract in the Huntington protein (HTT), which cause selective loss of striatal cells in the brain. In spite of the ubiquitous expression of normal and/or mutated Htt in the body, the genetic mutation is insufficient to explain the selective vulnerability, variability in age of onset and disease progression. This suggests that other factors contribute to the clinical manifestations of Huntington's disease.

Many studies have investigated the interaction between attention and multisensory integration in adults, but much less is known about how this complex relationship develops during childhood. The current research is to optimize multisensory attentional cueing tasks for research on children and to ensure that the child version of the task does not differ from the standard adult task.

My work is focused on connectivity analysis of fMRI data. In particular I applied Dynamic Causal Modeling (DCM) technique to investigate how well theoretical models of functional connectivity fit fMRI data. This past summer, I worked with fMRI data recorded during a two-choice decision-making task. Using DCM, I investigated how well the neural diffusion model (NDM) fit the observed functional connectivity from the fMRI data of this task. The NDM is an artificial neural network that is based on the drift diffusion model—a hallmark tool used to investigate different components of decision making processes popular in both the cognitive psychology and cognitive neuroscience communities.

Reaction time variability in timing and decision making

Empirical Testing of the Drift Diffusion Model of Decision Making via a Brightness Discrimination Task

The drift diffusion model (DDM) mathematically simulates how people make two-choice decisions as a process of evidence accumulation up to a threshold level that triggers a response. I used MATLAB to simulate decision reaction time data using various combinations of DDM parameters. By varying the drift (rate of evidence accumulation) across trials while holding the threshold constant, I found that the micro speed-accuracy tradeoff (mSAT) curve sometimes decreases over time, meaning that slower responses are less accurate than faster ones.

Role of prefrontal cortex GABA function in cognition

Schizophrenia is characterized by cognitive symptoms: cognitive, psychiatric, and motor. The genetic mutation in the Huntingtin gene (Htt) from different sensory systems is processed and integrated in the brain. Accurate integration from different sensory modalities is essential to our everyday functioning and lives. Past studies have shown that individuals with Autism Spectrum Disorder (ASD) have difficulty integrating multisensory information and have uncovered a possible genetic connection between sensory perception and ASD.

Role of prefrontal cortex GABA function in cognition

The prefrontal cortex is critical for optimal cognitive functioning, thus neuropathology on this brain region may lead to poor outcomes of afflicted individuals. Evidence from post-mortem analyses suggests that inhibitory γ-aminobutyric acid (GABA) neurons are dysfunctional within the prefrontal cortex of people with schizophrenia. The prefrontal cortex is critical for optimal cognitive functioning, and its neuropathology within this brain area may contribute to cognitive deficits observed in schizophrenia.

I am working with Professor Simen on developing experiments to test a new computational model of decision making in response to a somatosensory stimulus. There is a well-documented law, Weber's Law, which states that if you keep the proportion between two stimuli the same, accuracy should stay the same. This semester I will be testing these predictions by running human participants in a computer-generated, two-alternative forced choice brightness discrimination task. If the model’s predictions fit the resulting experimental data, this will constitute strong evidence for the model.

Introduction to mammalian cell culture and techniques used in neurotoxicology

I volunteered in Gunnar Kwakye's lab over the summer of 2013 where I was introduced and trained to work with mammalian cell cultures. In addition, I learned how to design and conduct experiments aimed at understanding the cellular mechanisms that underlie the toxic effects of chemicals on the nervous system in a Huntington's disease cell model.