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Office of Undergraduate Research

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Spike-LFP Correlation Within the Turtle Electrophysiology Project  
Aaron Foote

Delinquents, Deviants, and Dependents: A Comparative Study of Young Black Females at the Missouri State Industrial School for Negro Girls and the Virginia State Industrial Home for Colored Girls  
Lauren Henley

Too Cute For Words: An Investigation of Prosody’s Role in the Construction of Aegyo as a Speech Style  
Shelby Strong

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The logo for the Office of Undergraduate Research, on the front cover of this publication, consists of an “impossible triangle” within a starburst. To some, the triangle evokes the challenge of puzzles to be solved or the eternal research question “How does that work?” To others, the triangle represents the Greek letter Δ, the mathematical symbol for change.
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The authors and peer review editors of the Fall 2012 Washington University Undergraduate Research Digest welcome you to this volume. As more undergraduates engage in research in a greater diversity of disciplines than ever, undergraduate research continues to grow in importance at the University. The work reported in this publication has been recognized as significant by faculty and their academic departments at Washington University as well as by academic and professional societies far beyond our walls.

The three articles featured in this edition of the WUURD represent the multifaceted interests of the authors and their faculty mentors at Washington University. Aaron Foot, a Physics major, explores the electrical signals passed through the visual cortex of turtles to better understand vision. Neurophysics sits at the interface between physics and biology and medicine and Aaron’s work employs the tools of physics including electronic signal analysis to investigate a physiological process. The data he has collected so far provides evidence of a strong correlation between action potential spikes and the local field potential spontaneously produced in the visual cortex. Researchers will now begin to analyze signals resulting from specific, controlled visual stimuli to further understand the nature of neural activity related to vision. Lauren Henley digs deeply into two institutions that housed young African-American girls deemed delinquent during the early twentieth-century. A student of History, Lauren was given access to records from each institution that is unprecedented for an undergraduate. She used this information to understand how the creation of and practices at each school served to prepare its inhabitants for the future. Lauren found that a single individual, Ms Janie Porter Barrett, overwhelmingly influenced many aspects of her “school” and the ultimate outcomes for its inmates as compared to those at the other institution. The work reported here was conducted when Lauren had only completed her freshmen year at Washington University and could lead to a possible film. Shelby Strong’s work brings together her academic interests in linguistics, Korean language and culture, and gender identity. She analyzes phrases uttered in aegyo, a very new form of expression in Korean pop-culture, for certain specific aspects of speech including pitch range and boundary tones. Initial findings indicate that phrases repeated in the aegyo style are measurably different in mean pitch than are the same phrases in non-aegyo style. This analysis of aegyo is one of a very few to be published in English and may be used to create a working definition of the very popular phenomena.
The Summaries of Student Work section is filled with reports from students exploring a rich diversity of disciplines. Mentored by faculty for whom each student has expressed sincere gratitude, the works will continue to place Washington University in St Louis in the forefront of national and international scholarship. Many of the summaries contained in the WUURD report work that has or will be disseminated to experts in the respective fields of study. Many students publish the results of their research in academic and professional journals and present it at conferences and meetings. This digest is evidence of the outstanding students and faculty who do their work at our university.

Finally, the authors and editor must recognize the contribution of the Peer Review Board. These individuals selected and edited the feature articles presented herein. The excellence and level of professionalism of the WUURD is due in large part to their work. On behalf of the authors as well as myself, I wish to express our sincere appreciation for a job very well done.

We welcome you to enjoy and become inspired!

Respectfully,

Kristin Sobotka

KRYSTIN SOBOTKA  
Editor
**ABSTRACT**

Correlated neural activity within the brain results from the organized behavior of thousands of neuronal cells. In this study, we examine the coordinated neural response to a stimulus in the visual cortex of turtles (*Chrysemys scripta*). We seek to test the relationship between the low frequency local field potential (LFP) and the action potential spikes of individual neurons by directly measuring electrical activity in the visual cortex. There are two contributions to the local field potential, the correlated activity of nearby neurons and the synaptic input into local neurons. If a correlation between action potentials and local field potentials exists, then we seek to understand the sources of the correlation. Fully exploring this correlation is made easier by the use of the Turtle Electrophysiology Project, an experiment and data management system that automates much of the data collection and analysis required. Additionally, we incorporate a spike detection program called Spikepy in order to further interpret our data. The spike – LFP relationship is examined through the creation of analysis scripts in python that draw on libraries of code from the Turtle Electrophysiology Project as well as the detection and filtering abilities of Spikepy. We found that there is a strong correlation between the local field potential and action potential spikes measured in the visual cortex, bringing us closer to understanding the nature of correlated neural activity.

**FACULTY MENTOR: RALF WESSEL PH.D. ASSOCIATE PROFESSOR OF PHYSICS**

Professor Wessel’s NeuroPhysics group seeks to delineate principles of visual information processing at the level of spatiotemporal network dynamics in optic tectum and visual cortex. The central component of the NeuroPhysics research program consists of in vitro electrophysiological recordings of cortical activity in the turtle eye-attached whole-brain preparation in response to computer-controlled visual stimulation of the retina. The synergy of advanced neurotechnology, comparative in vitro physiology, and physics-inspired theory provides a fertile opportunity to advance our understanding of cortical microcircuit function.

**ACKNOWLEDGEMENTS**

I would like to thank Dr. Ralf Wessel for his guidance and support as I entered the world of neurophysics. I would also like to thank Caleb Wright and Jeffery Pobst for their helpful advice and for making me feel accepted in the lab. This research was supported both by Dr. Wessel and the Department of Physics. Lastly, I would like to thank the Office of Undergraduate Research for making projects like mine possible.
INTRODUCTION

Though the field of neuroscience has made great advances since its inception, researchers continue to grapple with unanswered questions. The process through which photons colliding with optical nerves in the back of the eye are converted into mental images remains poorly understood. Neuroscientists are currently trying to map the specific regions of the brain that contribute to this process and the type of electrical activity that the process generates. Uncovering the relations between the brain’s different electrical signals is critically important to the success of this research.

Within layered groups of neurons, such as those in the brain’s visual cortex, a stimulus generates several types of electrical signals. In order to better understand complex neurological phenomena, such as vision, one must look at the relationship between all types of signals, not just the individual features themselves. One such signal is an action potential, a rapid depolarization and repolarization of an individual neuron’s cellular membrane used to transmit information across a cell. This registers as a high frequency (~1000 Hz) deflection spike when measured via an electrode near the polarizing neural tissue. Another feature, the local field potential, or LFP, is a low frequency (~300 Hz) deflection caused by synchronized electrical activity across a region of neural tissue. The LFP amplitude increases during high levels of correlated activity and during periods of increased synaptic input into the nearby neurons.

To measure this activity, we analyze the synchronized neural response to stimuli in the visual cortex of turtles (Chrysemys scripta). While similar experiments have been performed with other small animals, the turtle has a biological mechanism that enables their brains to continue functioning without oxygen for extended periods of time. In practice, this makes data collection less time sensitive, as we are still able to evoke a signal after the turtle brain has been separated from the body’s oxygen supply for some time. We gathered two kinds of data from the turtle, searching recordings and visual recordings. Searching recordings are traces of spontaneous electrical signals that are not generated by a controlled stimulus. Visual recordings, however, are collections of responses to a specific visual event such as a flash of light.

The Turtle Electrophysiology Project, or TEP, is a database system that provides an organized framework that stores and analyses our recordings. Written primarily in python, it enables the user to form collections of searching or visual recordings and tag them with useful notes. The TEP also contains libraries of code for organizing, analyzing, and plotting results from data. The collections can all be created and edited using Search GUI program that is built into the database. Similarly, the python based application Spikepy is a useful tool for analyzing spikes and electrical traces. It provides a flexible framework that can be modified through plug-ins to perform a wide variety of functions, depending on the user’s needs.

METHODS AND PROCEDURES

Our study combines biophysical methods with software infrastructure to test the relationship between spikes and LFP’s. To gather tracings, we begin by isolating the turtle eyes, optic nerves, and brain from the body through a lengthy dissection
process. The turtle is anesthetized to facilitate the removal of the head from the body. Excess bone and muscle are carefully cleared from around the brain and optical tissues. The Dorsal Ventricular Ridge (DVR) of the brain is cut and held open in order to expose the visual cortex without damaging optical neurons. The brain is secured into a specially-designed recording chamber, with the visual cortex open to the air. By inserting glass electrodes into neural tissue, we can take both extracellular and intracellular recordings from within the exposed visual cortex. The process of gathering data is largely controlled by a Lab View program within the TEP, enabling the user to change the type and duration of any visual stimuli. In order to gather visual recordings, one must choose a protocol that defines the characteristics of the stimulus delivered. Stimuli can range from flashes of light of varying color and duration to colored dots moving across a screen, each potentially producing a different stimulus.

Every recording taken from within the visual cortex is arranged into a collection. It is important that all data within a collection is gathered from the same location and electrode depth within the visual cortex in order to minimize variability within a collection. There are a number of ways to test the spike-LFP relationship, but they are all generated in a similar manner using python scripts. The TEP already contains libraries of code that are useful for spike detection and LFP analysis, in addition to Spikepy. Beginning with libraries of code, one can modify programs to perform slightly different functions or return the processed data in a more useful format. For example, the existing code in the database can be modified to analyze tetrode recordings instead of single electrode recordings, providing new opportunities for further analysis. The user must also write supplementary code that opens the correct files for each program and scales the script so that it can process data from a large number of recordings. Once the analysis script has been completed, it must be tested to ensure that it performs the desired functions.

In our experiment, we seek to test for the existence of a spike-LFP correlation through a multi-step process using a python analysis script. This first step of the process is to filter the raw voltage traces with low frequency and high frequency filters in order to separate the action potential spikes and the local field potential. This process is diagramed below.

![Figure 1](image)

**Figure 1**

The raw trace shown on the left is filtered using a high pass filter and a low pass filter, producing the two modified traces on the right. The top right recording contains only low frequency local field potential deflections. Any low frequency activity has been removed from the figure on the bottom right so that only high frequency action potential spikes remain. The spikes are identified by the heavy lines on the bottom of the figure.
Separating the local field potential trace and the spike trace is essential in order to accurately quantify the number and magnitude of the characteristics of interest. For both filtered traces, we divide the recordings into one second intervals to expose any potential associations between the LFP and spikes. For the trace containing only high frequency spikes, we use a Spikepy plug-in to detect any action potential spikes that may occur within a one second interval from the trace. This plug-in identifies any spike that is more than six standard deviations above the mean value of the trace and outputs the number of spikes found as a list. Each element in the list indicates the number of spikes detected in the corresponding one second interval. For example, for a ten second recording, Spikepy would output a list of the following form:

\[ [0, 2, 1, 0, 0, 1, 0, 0, 0, 3] \]

With this sample result, we see that there are no spikes in the first one second interval of the trace, two spikes in the second interval, one spike in the third, and so forth.

For the filtered trace containing the low frequency LFP features, we create a script to calculate the area underneath the recording in order to measure the magnitude of the local field potential. We examine the absolute value of the filtered trace to measure the magnitude of the LFP, and calculate the total area under the trace for each one second interval. For a ten second trace, a possible output for this area program would be in the form:

\[ [0.015, 0.0334, 0.0445, 0.0254, 0.0245, 0.027, 0.01, 0.020, 0.0323, 0.0415] \]

In this case, the area under the trace on the first one second interval would be 0.015 mV/s and so forth. We set both the spike detection and area portions of our analysis script to output the relevant data as a list in order to best observe any correlations between the two.

The final portion of our python script plots the elements of the area under the curve list with the elements of the spike detection list on the Cartesian coordinate system. For every one second interval, there is both a spike number and a trace area associated with it. Using the sample ten second recording given above, we would see a plot with ten points with the following coordinates:

\[ \{(0, 0.015), (2, 0.0334), (1, 0.0445), (0, 0.0254), (0, 0.0245), (1, 0.027),
(0, 0.01), (0, 0.020), (0, 0.0323), (3, 0.0415)\} \]
Graphing these sample data points on a trace area vs. spike number plot produces the result below.

![Graph 1](image.png)

**Graph 1**

This graph is a sample of the final output of the analysis script used in our experiment. The vertical axis is the area underneath the signal, which increases during high levels of local field potential activity. The horizontal axis is the number of spikes detected by Spikepy. Each data point represents a one second interval of time, and its position on the vertical and horizontal axes is determined by the signal area and the number of spikes detected on that interval.

This plot contains only ten sample data points, corresponding to 10 intervals of time. When analyzing collections of recordings, however, every brief time interval from every recording within the collection is displayed on the resulting graph. With this large sample size, any correlation between spike number and trace area would theoretically become clear. To quantify the correlation, we determine the line of best fit for the set of data points. We extract the slope of that line as well as how closely the line fits the set of data in order to compare analysis results between collections.

**RESULTS AND ANALYSIS**

**Spontaneous Recordings**

After analyzing a total of seven collections, each containing a minimum of 38 spontaneous recordings, we see a clear pattern emerge. There is a largely linear, proportional correlation between the number of spikes and the area underneath the local field potential. This is consistent with our hypothesis that the action potential spikes and the area underneath the signal are correlated in some way. On the following page are two sample graphs of our data, divided by collection number. In order to be consistent, the collections are organized so that each recording in the collection is taken from the same sample at the same electrode penetration depth.
Graph 2a

SRCollection 30 (60 Single Electrode Recordings)

\[ y = 0.001435680418175893x + 0.0047144592647673485 \]

\[ R = 0.94079665270370438 \]

\[ R^2 = 0.88509834173849455 \]

Graph 2b

SRCollection 34 (259 Single Electrode Recordings)

\[ y = 0.0013529244904256475x + 0.0044790228263099831 \]

\[ R = 0.92787756865810367 \]

\[ R^2 = 0.86095678241887386 \]
Each data point shown in the plots above corresponds to a one second interval within a spontaneous recording in the indicated collection. Though some collections show more precise results than others, there is a subtle but significant curve at low spike numbers that prevents the data from being completely linear. However, as the magnitude of the spike number and area increases, the graphs each show asymptotically linear behavior. It is also worth noting that the lines of best fit for each data set never cross the origin. Since each point represents a one second interval of time, it is unlikely that the total signal area would be zero or nearly zero over such a long period. This lack of intercepting the origin can be further explained by the fact that, with our method, it is impossible for a trace to output data points with a negative area. These two consequences of the experiment's analysis method could also explain why there is a slight curve at low spike numbers.

We summarize some important characteristics of the best fit lines in the table below.

<table>
<thead>
<tr>
<th>Searching Recording Collection Number</th>
<th>Linear Slope (mV/(s*spike number))</th>
<th>R (Linear Regression Constant)</th>
<th>R^2 (Linear Regression Constant Squared)</th>
</tr>
</thead>
<tbody>
<tr>
<td>26</td>
<td>0.00155</td>
<td>0.87563</td>
<td>0.76673</td>
</tr>
<tr>
<td>27</td>
<td>0.00181</td>
<td>0.81498</td>
<td>0.66420</td>
</tr>
<tr>
<td>28</td>
<td>0.00158</td>
<td>0.95196</td>
<td>0.90622</td>
</tr>
<tr>
<td>29</td>
<td>0.00156</td>
<td>0.93200</td>
<td>0.86861</td>
</tr>
<tr>
<td>30</td>
<td>0.00143</td>
<td>0.94080</td>
<td>0.88510</td>
</tr>
<tr>
<td>31</td>
<td>0.00132</td>
<td>0.93366</td>
<td>0.87172</td>
</tr>
<tr>
<td>34</td>
<td>0.00135</td>
<td>0.92788</td>
<td>0.86096</td>
</tr>
<tr>
<td>Average</td>
<td>0.00151</td>
<td>0.91099</td>
<td>0.83193</td>
</tr>
</tbody>
</table>

Table 1

The line of best fit for every collection possesses an R value above 0.8, and if the first two collections are ignored then each line possesses an R value above 0.9. This indicates that the data is fairly precise, and the observed linear trend is significant.

Shifted Spontaneous Recordings
There is a possibility, however, that the time between an action potential spike and a period of increased signal area is synchronized in such a way so that our data could be misleading. For example, if there is an action potential spike 0.5 seconds into the recording, and the associated period of increased signal area does not begin until one second later, then the spike and the correlated LFP area would not be measured in the same time interval. To test for this effect, we altered the python script by shifting the one second interval window by 0.5 seconds. For a recording of duration N seconds, this results in time intervals such as:

\[[(0.5s, 1.5s), (1.5s, 2.5s), (2.5s, 3.5s), (3.5s, 4.5s), \ldots (N - 1.5s, N – 0.5s)]\]
While maintaining every other aspect of our analysis script, we gathered a new set of data with the altered windows. It should be noted that there was an anomaly within Collection 30 that made this shifted windows analysis impractical, so only 6 graphs of searching recordings were recorded.

The trends observed using standard time intervals were repeated when each window was shifted by 0.5 seconds. Though individual values changed, the overall pattern remained consistent with the earlier part of the experiment. The important characteristics of these shifted time windows are summarized in the table below.

<table>
<thead>
<tr>
<th>Searching Recording Collection Number</th>
<th>Linear Slope (mV/(s*spike number))</th>
<th>R (Linear Regression Constant)</th>
<th>R^2 (Linear Regression Constant Squared)</th>
</tr>
</thead>
<tbody>
<tr>
<td>26</td>
<td>0.00154</td>
<td>0.86630</td>
<td>0.75048</td>
</tr>
<tr>
<td>27</td>
<td>0.00177</td>
<td>0.81891</td>
<td>0.67061</td>
</tr>
<tr>
<td>28</td>
<td>0.00154</td>
<td>0.94552</td>
<td>0.89400</td>
</tr>
<tr>
<td>29</td>
<td>0.00157</td>
<td>0.95010</td>
<td>0.90269</td>
</tr>
<tr>
<td>31</td>
<td>0.00131</td>
<td>0.92762</td>
<td>0.86049</td>
</tr>
<tr>
<td>34</td>
<td>0.00136</td>
<td>0.92962</td>
<td>0.86420</td>
</tr>
<tr>
<td>Average Values (shifted)</td>
<td>0.00152</td>
<td>0.90635</td>
<td>0.82375</td>
</tr>
<tr>
<td>Average Values (standard)</td>
<td>0.00151</td>
<td>0.91099</td>
<td>0.83193</td>
</tr>
</tbody>
</table>

*Table 2*

Comparing the features of the lines of best fit plotted for the standard windows and the shifted windows shows little difference between the two. As a result, we are confident that the trends observed are significant and worth further examination.

**CONCLUSION**

The relationship between action potential spikes, signal area, and local field potentials within the visual cortex of turtles is a complicated one. There are multiple reasons for a spike to occur, and the LFP is influenced both by correlated synaptic activity and neural input. These many variables present a challenge when attempting to further understand the nature of the spike-LFP correlation. However, using the Turtle Electrophysiology Project, python plug-ins such as Spikepy, and a unique analysis method, we have observed a pattern between action potentials and the signal area present in spontaneous recordings. The linear trends measured thus far from spontaneous recordings do little to explain the details of that correlation, only that it exists and it is worth studying further. For visual recordings, our methods need to be further modified in order to observe patterns in the spike-LFP correlation. Does the correlation still exist in response to a specific stimulus, or does one feature dominate over the other? How long after a controlled stimulus is there a maximum number of action potential spikes or the greatest amount of signal area?
The next step in our research is to analyze visual recordings, which result from specific and controlled stimuli. In these cases, simply dividing the recordings into one second intervals becomes less useful. For visual recordings, we hypothesize that the action potential and LFP area would be correlated to the movement of an object across a screen, a flash of light, or another similarly simple stimulus. As a result, we think it will be necessary to divide visual recordings into longer time intervals based on what kind of stimulation is occurring at that time. We will examine visual recordings that use a series of black dots moving across a white screen as a stimulus. We will divide each recording into four separate intervals: pre-stimulus, stimulus, inter-stimulus, and post-stimulus. The pre-stimulus category is the time interval that existed before any dots began moving, while the stimulus period is any interval of time during which a black dot was moving. The inter-stimulus period is defined as the time between moving dots, and the post-stimulus period is the time after which all dots have stopped moving for that recording. The spike number and signal area across each of these four periods is normalized to one second in order to make comparisons clearer. Therefore, we will output the number of spikes per second and the signal area per second for each type of stimulus interval, graph those normalized values, and examine any trends that occur.

NOTES

Delinquents, Deviants, and Dependents:
A Comparative Study of Young Black Females at the Missouri State Industrial School for Negro Girls and the Virginia State Industrial Home for Colored Girls

Author:
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Lauren is a sophomore at Washington University majoring in History. She is an Ervin Scholar, a member of Phi Alpha Theta National History Honor Society, and a member of the Association of Black Students. Her interest in black female juvenile delinquency has blossomed while finishing coursework with Dr. Sowande’ Mustakeem. She intends to expand this research project, with the potential of completing a Seniors Honors Thesis on a related topic.

ABSTRACT
At the dawn of the twentieth century and at the height of Progressivism, numerous institutions for wayward black youth opened throughout the United States. Concentrated in the South, many of these facilities separated youth by gender. Through examining archival records, articles, and books, this study compares the Virginia State Industrial Home for Colored Girls and the Missouri State Industrial School for Negro Girls. While the former facility was considered a model reformatory dedicated to rehabilitation of its pupils, the latter was a deplorable prison-like structure, underfunded and neglected by the state. This investigation compares these two institutions by looking at four points of differentiation: creation, logistics, discipline, and inmates. The creation of these reformatories set the foundation for their opposite trajectories in subsequent years. Similarly, the logistics at both institutions, ranging from staffing to food rations and chores, contributed to their successes and failures. Both schools created plans for behavior which incentivized the girls to act appropriately in order to achieve parole, yet the differences in the policies had noticeable effects. Lastly, the differences in inmates sent to both facilities were minimal but worthy of discussion. By comparing these two institutions, it is possible to uncover hidden truths about what went on behind the closed doors of youth reformatories and the plight of young black females growing up in urban environments in the early twentieth century.

KEY TERMS
• Juvenile Delinquency
• Black Females
• Juvenile Reformatories
• Progressivism

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Peer Editor:
Rachael Tellerman, a senior majoring in Painting
Growing up in an era of lingering Victorian ideals and strict social class, many juveniles’ attempts to exert a semblance of freedom were mistaken for unacceptable acts of criminality in the United States. As the nineteenth century came into focus, the values of the Progressive Era trickled into conversations concerning the welfare of the country’s most vulnerable population, the children. Adults began to realize the malleability of the younger generation, which often made youth susceptible to a variety of influences, both positive and negative. Many reformers organized under a child-saving mission, seeking to better the lives of disadvantaged, poor, and wayward youth.

While the “child savers” of this era worked tirelessly to promote the general welfare of all children, it must be noted that the definition of a delinquent child versus a dependent one was often blurred. Although dependent children were initially seen as victims of circumstance and delinquents were considered to have criminal intentions, oftentimes youth floated between these two categories due to their urban environments. Moreover, issues of race and gender are often overlooked when applauding the efforts of these once revolutionary and selfless individuals. Despite progress made during the early twentieth century in juvenile justice and the triumphs of the child savers, many black children were forced to turn inward, “rely[ing] on their own people” for various forms of support, and encouragement. Even so, the model of “state-as-parent” became the most common way to handle both delinquent and dependent youth, and by separating them by gender and race, inequality and segregation were inevitable.

Young black females were particularly marginalized under this new system, committed to subpar facilities based on crimes which were often vague and unfair. As Steven L. Schlossman notes, “When girls appeared in juvenile courts and were committed to reformatories, however, one factor was always present: sexual promiscuity, real or suspected.” While the idea of promiscuity was usually associated with delinquent females, dependent girls often faced similar discrimination and sentencing practices. Although dependency frequently stemmed from overworked and underpaid parents, overcrowded living conditions, and racial segregation, many young black girls who suffered this fate were deemed as socially undesirable as their sexually deviant counterparts. By no means do these two labels encompasses the breadth of cases which passed through the juvenile courts in the early twentieth century, but these distinct yet overlapping categories can help to unravel some of the truths regarding the treatment of black female juveniles from the courts to the reformatories.

This study presents a comparison of two industrial schools for black girls in the early 1930s. The first school, located in Tipton, Missouri, was considered a pitiful, yet functioning segregated reformatory. Located far from many resources and obviously underfunded, the Missouri State Industrial School for Negro Girls provided a challenging home for the one thousand girls who passed through its doors, often unsure of their sentence and even more unsure of their futures.

In contrast, the Virginia State Industrial Home for Colored Girls was the first such school to have been built in America, prized for its ideal location, commitment to virtues, and successful rehabilitation. Mrs. Janie Porter Barrett, one of the most prominent black females in Virginia during the early twentieth century, worked with the Virginia Federation of Colored Women’s Clubs to establish and maintain this model reformatory until it was handed over to the state in 1925. Despite this logistical change, the Barrett School continued to excel, allowing its students to reach
high academic standards while turning wayward girls into socially admirable young ladies.

Interestingly, based on the child savers’ principles established at the turn of the century, both of these schools should have flourished, providing safe havens for delinquent and dependent young African American females, supposedly equal in every way to the reformatories created for their white counterparts. However this research finds that the ideal dreams of these schools were never fully realized. By examining the Missouri State Industrial School for Negro Girls and the Virginia State Industrial Home for Colored Girls in terms of their creation, logistics, methods of discipline, and the girls who were committed as inmates, this study seeks to identify the similarities and differences between these two reformatories. Through this comparison, it is possible to conclude that black female juveniles were more successfully rehabilitated based on the standards of Progressivism in the Virginia school as opposed to the one in Missouri.

CREATION

While both the Missouri State Industrial School for Negro Girls and the Virginia State Industrial Home for Colored Girls were created to serve the same purpose for their respective populations, the reality which governed their establishments put these institutions on separate pathways, one headed towards success and the other doomed towards failure. By revealing how both schools were established and emphasizing the challenges they faced, it is possible to better understand the unequal realities suffered by young black females who were labeled as delinquents, dependents, and wards of the state.

Tipton, Missouri

Opened in 1916, “The Missouri Industrial Home for Negro Girls at Tipton housed more than one thousand black juveniles” over the forty years it was in operation. 4 This state-run school was initially designed and implemented to rehabilitate otherwise unsalvageable black females, particularly after the shocking rumor that “a twelve-year-old girl was reportedly committed to the state penitentiary in 1908.”5

While wayward white girls were whisked away to Chillicothe, in Livingston County, “the legislators who voted to create Tipton were frankly troubled over the question of what to do with black female juvenile delinquents.”6 The struggle to establish this reformatory began at least as early as 1909, but the delay in the project’s completion stemmed from the fact that the site was originally determined unsuitable by nearby residents due to racial prejudices. When it was finally determined that the school be built in Moniteau County, the issue of funding caused yet another road block, clearly foreshadowing the struggle the school was soon to face.

With Tipton officially opening its doors for the reception of inmates on May 15, 1916, many in the state thought the issue of where to house delinquent black females had finally been solved and reasonably far from the public eye as well.7 At first, the legislature was proud of its achievement, rattling off deceptively impressive figures including, “its building and wing is capable of caring for 120 girls” and “the home has its own power house and light plant.”8 While these facts might have been true at the inception of Tipton, they quickly crumbled under the stark reality that there was
neither adequate space nor sufficient resources to handle the wide array of girls who were soon to be committed. In fact, “in order to even hold school for the girls, the institution was forced to salvage chairs and small tables from vacant rooms around the facility because there was no money allocated by the state to purchase furniture.”

The industrial school at Tipton was, almost from the very beginning, Missouri’s attempt to put the issue of wayward black females behind closed doors and hidden from public view. It was located at a physically disadvantageous site and also suffered because “political patronage determined who would govern the institution, leaving well-meaning but ineffective leaders…to deal with an often too large number of girls.” All of these problems manifested themselves with greater ferocity as the years went by, but the basic symptoms can be traced to the establishment of the school.

Peakes, Virginia
Contrastingly, the Virginia State Industrial Home for Colored Girls started off with a bright and eager future ahead, backed by private funds and the Virginia State Federation of Colored Women’s Clubs. Mrs. Janie Porter Barrett, founder of the school, quickly recognized that “the thing most needed in Virginia was a home school for young colored girls who, falling into the hands of the law, were being sent to the jails in company with older and hardened criminals.” After three years of dedicated fundraising from the Federation, the land of Mill Farm was secured at Peakes (also known as Peake and Peaks Turnout) in Hanover County. A very lucrative plot of land and full of useable soil, the farm consisted of “one hundred and forty-seven acres,” as well as a functioning mill and well water. The resourcefulness of the area and the support from the local community helped the school to flourish in its opening years.

Although girls were received at Peakes only a few months before Tipton’s first inmates arrived, the underlying support for the former institution was both more financially stable and more easily controlled by privatized sources. While Tipton received minimal funding to construct its first building, the land at Peakes already contained a useable farmhouse, which would house girls until additional buildings could be erected. The almost immediate construction of new facilities at Peakes, as opposed to dismal conditions at Tipton, helps to underscore why the Virginia State Industrial Home for Colored Girls was revered as one of the most successful facilities of its type.

Lastly, perhaps the most noticeable difference in the prosperousness of both schools can be traced back to the support, or lack thereof, from the white community. In Missouri, while the state legislature was supposed to be nonpartisan, the reality was that of a segregationist philosophy. Many people did not want wayward black girls living in their community, based on preconceived beliefs in inherent criminality, suspicious behaviors, and dangerous tendencies. Yet in Virginia, Mrs. Barrett’s opinion was respected throughout the state due to her association with the white community. Moreover, the organizational support from the Federation provided credibility to the cause, giving the state even more reason to allow privatized building, rather than the inevitable establishment of a state-run institution. Though never explicit in the creation of either school, the influence of the white majority over the black minority had significant consequences, which worked favorably at Peakes, and rather unsatisfactorily at Tipton.
LOGISTICS
While it would be possible to compare the schools from their creation until their closings decades later, this paper seeks to give a brief snapshot of the experiences at Tipton and Peakes focusing on the early 1930s. Both institutions saved many records from this decade and the period is extremely rich in historic context in that the Great Depression put severe pressure on many families. Additionally, the values of the Progressive Era were firmly established. By using state government records, critical analysis, and a general understanding of the time period involved, this work leaves room for consideration of facts and opinions. It is important to note that many sources are contradictory, which is helpful in recognizing the varied perspectives on such institutions, but also burdensome when trying to recreate narratives which capture lived experiences.

Tipton, Missouri
Before the 1930s, the Missouri State Industrial School for Negro Girls was placed under the control of the Department of Corrections. As a result, the years following Tipton's opening were a mix of external pressures attempting to utilize the facilities like a traditional state penal institution and select individuals within the school who tried to push back, often through basic attempts at self-sufficiency with the few resources available to them. The day-to-day living conditions at the school hindered many girls from learning how to be reintroduced into society even though they often mastered domestic skills, vocational training, and feminine habits. They lived in conditions of perpetual hunger, cold temperatures, and overcrowded facilities and many girls truly struggled to survive.

Based on the biennial report from 1931, it appears that Tipton functioned much like any other reformatory for young black females of the time. All girls were seen by a doctor upon admittance. On the surface, this reflection on a girl's health seems to paint a positive picture of Tipton's facilities, though it entirely omits the pressing issue of why girls entered the school “physically rundown” in the first place and then were “nursed back to health.” When girls were whisked away to serve time at Tipton, few attempts were made to find alternative placement facilities first.

Academically, the reformatory was supposed to teach up through 10th grade, though there were only two teachers in the entire school. Along with classes, attempts to make the girls well-rounded included music lessons for those so inclined, as well as other fields of study including typewriting and beauty culture for inmates who met certain criteria.

Much like at a traditional prison, recreational time was mandatory. As Superintendent Shelby explained, “the girls are permitted to spend three hours daily at recreation, and one-half a day on Sunday on front lawn.” Though it appears the girls were given quite a bit of free time to spend as they chose outside, in reality they were often placed into organized sports or drills. Additionally, attempts to keep the girls healthy probably influenced their extended outdoor recreation, where fresh air and open space were thought to prevent the spread of diseases.

Despite being a state-run and publically-funded institution, a large component of the girls’ day-to-day experience was religious observances. As Superintendent Shelby explained, “these [religious] services lend encouragement to inmates to go to God
direct and be not afraid.” By using Christianity as the ideal faith of virtuosity, regardless of prior religious affiliation, girls found themselves immersed in religious beliefs almost as soon as they entered the doors at Tipton. Through religious training, academic growth, physical well-being, and vocational mastery, the staff at the school worked to offer the girls a chance at rehabilitation, though these efforts were often undermined by the dismal living conditions and the lack of state support and funding.

The reformatory in Missouri, unlike its counterpart in Virginia, frequently had to fight for state funds. Requests for much-needed improvements were frequently denied or deferred; therefore the bare minimum became the standard. Tipton might have had sewing classes and training in domestic arts, but these extracurricular activities attempted to mask the financial strain on the institution. Very little of anything was purchased for use at the school which resulted in the girls having to make their own clothes and linens, can the scarce produce grown in the garden, and even milk the dairy cows used to serve the student body. Although some of these skills were thought to be necessary for making a future living, the responsibility of having to survive in this environment certainly created tension at the institution.

Peakes, Virginia

Less than five years after it opened, the Virginia State Industrial School for Colored Girls came under state control; however this shift in leadership had little effect on the institution’s successful operation. The transition from private to public control was a very smooth one in which the daily functioning of the school remained as solid as ever.

Moreover, the principles on which the school was built promoted both well-rounded excellence and a commitment to individuality. In contrast to Missouri, special care was taken to make sure the school was the last resort possible for the girls: serious attempts were made to place them in foster homes and with other family members before they were ever admitted to Peakes. Mrs. Janie Porter Barrett’s explanation of the school’s purpose is perhaps the best way to describe exactly what transpired at the institution. She called it a “moral hospital where each girl is studied and given individual treatment, with the hope of removing the cause of her delinquency and of building character.” Knowing that this focus drove the operations at the school, it should come as no surprise how girls were treated from their very first day.

As at Tipton, girls were seen by a doctor when they were sentenced, simply as a matter of formality. Next, “upon arrival, each girl was assigned to Virginia Cottage for social assessment.” The purpose of sending the girls to Virginia Cottage was not only to give them a place to stay until they earned the privilege of living in one of the nicer buildings, but also gave them the chance to start anew. Mrs. Barrett was adamant that her girls be given the opportunity to forget their pasts and be welcomed into a loving and devoted community of adult supporters and adolescent companions. From the very beginning the girls at Peakes were treated with a certain level of respect and were hence expected to show such respect in turn. Using this philosophy, the daily experiences at Peakes were similar to Tipton in their basic premises, but very different with regard to intention and purpose.

Much like at its Midwest counterpart, academics played a significant role in daily life at Peakes. The difference, however, was that Peakes had ample resources to ensure
scholastic and vocational success for the girls in attendance. For example, “educational preparation paralleled the public school curriculum through grade eight, and the academic content was supplemented with...programs to promote English-proficiency skill.”19 Regardless of a girls’ educational upbringing prior to her admittance, Mrs. Barrett made sure the school strove to maximize each girl's potential.

Similar to Tipton, “religious training, crop harvesting, and household management were all part of the vocational education program” at the Virginia State Industrial Home for Colored Girls.20 Mrs. Barrett emphasized humility and Christian values, encouraging daily prayer while maintaining a “regular ‘open forum,’ at which the girls were given the opportunity to air their grievances freely.”21 By creating a safe yet open environment, “the goal of the industrial home school was to help each girl gain self-control and develop home-life skills in preparation for independent community living.”22 This “open forum” provided a safe space for mature dialogue between the girls and the staff and created a much more trusting environment than the rigid hierarchy at Tipton.

Whereas many girls at Tipton were forced to live self-sufficiently due to inadequate resources, girls at Peakes were encouraged to spend much of their free time learning and exploring. While girls did pick up domestic skills such as cooking, cleaning, gardening, and sewing, these chores did not hinder their exposure to outside air and other extracurricular activities. Rather than worrying over the next meal, the young girls had ample time to refine their skills in order to better their chances for independence upon their release.

Lastly, one of the most significant differences between Tipton and Peakes was the involvement of the superintendent. As can be surmised, the staff at Tipton was irregular and generally unfamiliar with child welfare and hence unfit to care for the girls. Superintendents never stayed for more than a few years and hiring staff to fill vacant positions was difficult: either because of the inconvenient distance, unsuitable salary, racial tensions or a combination of all three. In contrast, the sincere interests of Mrs. Barrett were showcased throughout her decades as superintendent of the school. She eventually “became an authority on child welfare problems in the United States,” and there is no denying that most of her firsthand experience came from her decades at Peakes.23 Even after many of the girls were released or paroled, Mrs. Barrett continued to keep in contact, urging her pupils to write her regularly with updates, concerns, and occasional requests.

**DISCIPLINE**

Although vocational training at the Missouri State Industrial School for Negro Girls and the Virginia State Industrial Home for Colored Girls was similar, the methods they used to discipline the girls varied in many ways. While girls at both facilities were eligible for parole if their behavior was satisfactory, the standards used to judge such successes differed. Regardless of the specifics of each institution’s merit system, it is important to note that Victorian virtues and feminine ideals, such as being submissive to one’s husband, were placed at the forefront of good behavior; even the state’s most helpless females were expected to become young women of dignity and honor.
Tipton, Missouri

Tipton saw its fair share of superintendents pass through its doors during its decades of operation and all of them demanded to be called “Mother.” This was supposed to create a familial atmosphere and a nurturing figurehead, though in reality the effect was minimal.

The role of “guardian Mother” was executed in a unique manner by each superintendent at Tipton. For example, Mother Bowles, who became superintendent in 1933, proposed “a strict regimen of work, worship and play,” focusing on making sure her girls were presentable for marriage rather than academics. She utilized a merit system (which had been established by her predecessors) to ensure that the girls at the school were meeting her standards, despite the meager resources at Tipton.

The merit system, in its most basic form, rewarded girls in five general categories every day. These rules of discipline attempted to show favoritism towards girls who excelled regularly, but also penalized those who struggled to adjust to life in the institution. Monthly, tallies from the merit system were accumulated to write progress reports on each girl, allowing the staff to track an inmate’s progress. By keeping record of a girl’s path through the school, the prospect of early parole (which was a rarity) provided an incentive for many inmates and assured staff that adequate behavioral improvement had been made.

Peakes, Virginia

As at Tipton, “Mother” was also commonly used at the Virginia State Industrial Home for Colored Girls. Rather than creating a hierarchy, Mother Barrett intended to become every girl’s new parent in almost every sense of the word. She felt the community created at the institution would be closer to a family simply if everyone felt related to one another.

Here too, a merit system was instigated. It was enforced with physical clothing distinctions rather than privileges, though girls could receive special freedoms if their behavior was outstanding. When a girl arrived at Peakes, she was cleaned and given a clean bed: signs that she could start all over. Mother Barrett would literally write her name across a clean page of paper, indicating a fresh start and a chance to confess to all past events without fear of judgment or denial. After the ten-day grace period of learning the school’s rules, the discipline system was enforced. Called the Honor System, the tactic of using demerits, silences, and rewards to encourage good behavior was the primary method of discipline used at Peakes.

Though both Tipton and Peakes attempted to create family atmospheres within the walls of their respective institutions, the discipline systems they employed created competition amongst the girls, rather than sibling-like camaraderie. While the former school seemed more focused on preparing girls for a future life supported by a man, the latter emphasized above average performance from the beginning, regardless of past experience. Girls at Peakes often wrote letters after their discharge thanking Mother Barrett for giving them the skills needed to be independent women working as laundresses, secretaries, seamstresses, and cooks. They were often reintroduced into society successfully, whereas girls at Tipton were dependent on men after their release since the school did not adequately prepare them for independent living.
INMATES
The girls who entered the Missouri State Industrial School for Negro Girls and those committed to the Virginia State Industrial Home for Colored Girls differed little. They had most often been charged with “delinquency,” which was a simple label for crimes such as missing curfew, attending a dancehall alone, or staying too late at a suitor’s house. Although the legal procedure for commitment was different in each state, the girls who eventually found themselves locked behind those walls were practically mirror images of one another, despite the hundreds of miles between the schools.

Tipton & Peakes
As previously mentioned, the vast majority of girls who entered reformatories during the early twentieth century had been sentenced for crimes of poverty and/or sexual promiscuity. While being courted by eligible suitors was often the highlight of a girl’s teenage years, she frequently walked a thin line between exploring her boundaries and disgracing her name. Moreover, young girls living in segregated cities, including Kansas City, St. Louis, and Richmond, often found themselves in impoverished conditions and thus committed petty crimes simply to find something to eat, help support the family, or experience a luxury such as seeing a show.

It is tragic to think that, although some girls committed punishable crimes, many others were sentenced to reform schools “for little more than their parents’ poverty.”28 Girls who were committed for serious crimes such as robbery and murder were housed alongside victims of neglect and abuse, though the majority of sentences received by girls at both schools were for petty or minor offenses.

That being said, it is important to acknowledge the legal differences in the crimes encountered both at Tipton and Peakes. While parents could report and bring their daughters to Tipton, both schools required legal proceedings before the state could intervene. Although girls at both institutions were most often sentenced as general delinquents, defined as those who engaged in activities that were deemed illegal, regardless of age, they were also charged with “general delinquency” for crimes which were only applicable to juveniles. Because of the ambiguities in defining the girls’ crimes, it is often difficult to tell the severity of these cases from records alone. Regardless, delinquency was the overarching issue at both institutions, which attests to the hard living conditions these girls endured while growing up in urban areas. In reality, many of the girls who were committed to Tipton and Peakes were simply considered uncontrollable by their parents and/or guardians.

CONCLUSION
Through a comparison of their creation, logistics, discipline, and inmates, it is possible to identify many of the similarities and difference between the Missouri State Industrial School for Negro Girls and the Virginia State Industrial Home for Colored Girls and to consider the outcomes for their inmates. While both facilities experienced southern prejudices and endured racially-motivated hardships, the separate paths of these institutions can be directly attributed to their initial foundation and the subsequent attention paid to them. In Missouri, not only did the state admit that it did not have a vested interest in the institution, but given that the Department of
Corrections had control over the institution at Tipton, it further implied that the girls deserved to be criminalized. In Virginia, in contrast, the privatization of the school at its inception had a profound impact on its future trajectory. The fact that respected individuals within the community were seriously concerned about the problem of delinquent girls and were willing to invest their own time, money, and resources to come up with a solution created an entirely different institution and outcomes for its inmates. Therefore, it may be concluded that Peakes was a true reformatory which was ultimately beneficial for its girls, whereas Tipton attempted to rehabilitate its girls but ultimately failed. While examination of these two state institutions only provides a glimpse into the treatment of young black girls during the 1930s, it works as a lens through which to analyze the racialized and impoverished conditions of girls from metropolitan environments during this time.

Notes

5 Doughlas E. Abrams, A Very Special Place in Life: The History of Juvenile Justice in Missouri, 16.
7 49th Annual House and Senate Journal Appendix, Missouri State Archives, 42.
8 49th Annual House and Senate Journal Appendix, Missouri State Archives, 42.
13 56th Annual House and Senate Journal Appendix, Biennial Report, Missouri State Archives, 276.
14 56th Annual House and Senate Journal Appendix, Biennial Report, Missouri State Archives, 276.
15 56th Annual House and Senate Journal Appendix, Biennial Report, Missouri State Archives, 279.
16 56th Annual House and Senate Journal Appendix, Biennial Report, Missouri State Archives, 278.
17 Legal Pad Notes from Betsy Brinson, The Virginia Historical Society.
18 Wilma Peebles-Wilkins, Janie Porter Barrett and the Virginia Industrial School for Colored Girls: Community Response to the Needs of African American Children, 152.


Too Cute For Words: An Investigation of Prosody’s Role in the Construction of Aegyo as a Speech Style

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Shelby is a senior majoring in linguistics and East Asian studies. In Amy Baily’s Freshman Writing I course, she researched representations of gender in the media for a paper on the anime heroine Sailor Moon. This experience fueled her passion for research topics such as equality, discrimination, power, gender, and sexuality. Since then, her classes have provided her with a wider range of tools and perspectives for the exploration of these interests, and have led her to conduct this study as part of her Senior Honors Thesis in linguistics.

KEY TERMS
• Aegyo
• Korean Tones and Break Indices (K-ToBI)

ABSTRACT
Research suggests that prosody can be used by speakers to convey a variety of information to listeners. The present study attempts to investigate how prosody might play a role in the construction of aegyo, a Korean term for a type of charming, cute behavior that may refer to both linguistic and non-linguistic behavior. The focus of this study was the speech style which uses linguistic features stereotyped as conveying cuteness or charm. To test the hypothesis that there is a significant prosodic difference between aegyo and non-aegyo, two experiments were conducted. In Experiment 1, subjects read aloud passages in Korean that were constructed to elicit contrastive speech performances. The subjects’ performance was expected to exhibit more or less aegyo depending on the context information embedded in the passages. While there was a significant difference between the mean pitch of utterances for two out of the three subjects, there was no significant difference between the pitch range and mean absolute slopes of contrastive utterances. Additionally, analyses revealed that seven of the nine widely recognized K-ToBI IP-final boundary tones occurred in both aegyo and non-aegyo utterances. In Experiment 2, two judges listened to and evaluated the clips of utterances derived from recordings made in Experiment 1. Despite some subjectivity in judging, there was a high level of concordance between the judges. The study concluded that there was some evidence, at least in the case of mean pitch, suggesting a prosodic difference between aegyo and non-aegyo speech. Due to the fact that very few subjects participated, it was concluded that the results could not be used to make inferences about other populations and that the study should be replicated in the future with a larger number of subjects.

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Professor Kessler currently studies psycholinguistics of reading and spelling. He is particularly interested in computational and statistical approaches to language, especially in the fields of phonology, historical linguistics, and the lexicon. His research has also explored how to statistically test the historical connections between languages.

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Peer Editor: Sarah Cohen, a senior majoring in English Literature and Psychology
INTRODUCTION

Aegyo is a Korean term for a type of charming, cute behavior frequently observed in contemporary Korean media including dramas, variety shows, reality shows, and televised music programs that feature appearances by Korean celebrity pop singers and idol groups as guests. Aegyo appears to be a type of performance that typically consists of either physical behavior or linguistic behavior or a combination of both that is perceived as cute. I have observed that in performances on television, females appear to be requested to perform aegyo more frequently than men and requests for aegyo are made of younger celebrities more frequently than older ones.

Despite aegyo’s seemingly pervasive presence in contemporary Korean media and despite the recent increases in the body of literature pertaining to Korean studies, only a few scholarly articles are written in English and, more often than not, only briefly mention aegyo. Therefore, I look to other research in the field of sociolinguistics, in particular speech styles and code-switching, as starting points for understanding aegyo. My observation of changes in pitch lead me to question the role that prosody plays in aegyo. The results of this study will be informative to a variety of scholars and non-scholars and will help establish a working definition of aegyo based on empirical evidence. This definition will be based on some of the linguistic features that often co-occur with speech perceived to be spoken in an aegyo speech style. The study will not answer questions of what aegyo “does”, (e.g. What are the motivations of speakers who employ aegyo? What does the employment of aegyo help speakers to achieve in their interactions?), but rather attempts to describe what aegyo “is” in part.

In the Dictionary of the Standard Korean Language aegyo is defined as a “cute manner or attitude that is shown towards others”.¹ This definition however does not provide an adequate description; not all cute behavior is aegyo. “Cute” and “aegyo” are neither synonymous nor do they hold equal weight in meaning and connotation depending upon the context.

Understanding and defining aegyo should not be marginalized. Inoue asserts that “Japanese women’s language” (onna kotoba or joseigo) is a “space of discourse—understood as a complex ensemble of practices, institutions, representations, and power—in which the Japanese woman is objectified, evaluated, studied, staged, and normalized through her imputed language use and is thus rendered a knowable and unified subject both to herself and to others”.² Likewise, I argue that aegyo is a socially constructed category and a part of a larger social discourse in Korea with far-reaching and significant consequences throughout society. The ability to behave in a cute manner is not biologically determined, though the frequent association of aegyo with females may be an effort to propagate this falsehood. Aegyo is made visible and circulated whenever it is performed or a performance of it is referenced. Individuals’ knowledge of aegyo is subjective, something that is learned from their experiences. It should be understood that aegyo is not something objective that can be defined universally across contexts. However, various social factors, such as the reinforcement of certain types of behaviors with positive or negative reactions, allow a norm for what is considered stereotypical aegyo to be maintained.

The sociolinguist Coupland wrote that “conventionalized associations often link
social categories together, for example, masculinity and ethnicity. There are many ways of being and talking ‘like a man’ or ‘like a black person’, but in some socio-cultural contexts the formation ‘masculine’ or ‘manly’ can come to be defined in terms of blackness. I would assert that aegyo can be perceived as a speech style, stereotypical in nature, that speakers may switch to or from to make salient the fact that they are indexing different social groups during conversation and therefore communicating their stance on a variety of issues, including their identity. Through his research, Barrett demonstrated that African-American drag queens are able to challenge and resist mainstream ideologies concerning gender and sexuality by switching between speech styles. It may be the case that performances of aegyo and style-switching involving aegyo may reinforce or subvert gender and sexuality ideologies. One of the objectives of this study is to provide information on the linguistic features that might potentially mark the aegyo speech style, information that will be useful for studies of style-shifting involving aegyo.

To investigate whether prosody significantly varies between aegyo and non-aegyo speech, four different variables were examined; mean absolute pitch slope, pitch range, mean pitch and IP-final boundary tones. Erez Levon defines pitch as “a perceptual phenomenon, intrinsically related to, but distinct from the physical act of vocal fold vibration. When the vocal folds vibrate, they always do so at a regular periodic frequency (e.g., 100 times per second, annotated as 100 Hz)”. Pitch varies between individuals, and as a result, a within subjects design was used for Experiment 1. The impetus for three of the quantitative measures, pitch slope, pitch range, and mean pitch, came from Levon’s research on the language of Israeli lesbians and gays. Levon’s research, among that of others, demonstrated that pitch plays a role in communicating information about the speaker’s gender and sexuality:

[Three features] of pitch considered showed themselves to be potentially linked with the men’s linguistic performance of their sexualities: pitch slope (a measurement of the relative speed in which pitch fluctuations take place), pitch range (the measurement of the amount of change in pitch across a stretch of talk) and mean pitch (the average pitch height of an utterance)…steeper pitch slopes, wider pitch ranges and higher mean speaking pitches are all saliently affiliated with a feminine style of speech, whereas flatter pitch slopes, narrower pitch ranges and lower mean speaking pitches are affiliated with a masculine one.

In the present study data collected was also qualitatively annotated using the Korean Tones and Break Indices Conventions (K-TOBI) written by Sun-Ah Jun. Jun wrote “the intonational structure of the standard dialect (=Seoul) of Korean has two intonationally defined prosodic units: Intonation Phrase (IP) and Accentual Phrase (AP)…An IP is marked by a boundary tone (%) and final lengthening”. According to Jun, the boundary tone occurs in the IP-final syllable and conveys pragmatic meaning and information about the sentence type. I hypothesize that there may be a significant difference between the types of boundary tones that are realized in the IP-final syllables of aegyo utterances and non-aegyo utterances.
METHOD

Experiment 1

Participants
Three native Korean speakers, two females and one male, voluntarily participated in the experiment, and were current undergraduates or recent graduates of Washington University in St. Louis between the ages of 20 and 23. All participants had lived in the Republic of Korea for 12 or more years, attended school in Korea for seven or more years, and had studied abroad, including their time spent attending college in the United States. All had studied one or more foreign language, including English, for 10 or more years and all stated that they were relatively fluent in English. All of the subjects stated that they were fluent in the standard Seoul dialect. One subject stated that he also spoke Gyeongsang dialect (경상도 방언) and another subject stated that she also spoke Chungcheong dialect (충청도 방언).

Materials
The experiment was divided into seven different tasks and all segments took place in the same location; a quiet, private sound booth. Tasks 1 and 4 of the experiment consisted of the subjects reading a passage aloud while being recorded. In Tasks 2 and 5, subjects were asked to answer three questions regarding the passages they read in Tasks 1 and 4. The data collected from Tasks 3 and 6 ultimately was not used but consisted of asking the subjects to retell the passages from Tasks 1 and 4 while being recorded. In Task 7, the subjects were asked to complete a demographic questionnaire to gather information about their background. The tasks took place in sequential order, e.g. Task 1 before Task 2 before Task 3.

The instruments used to collect data in Task 1 and Task 4 consisted of two passages. The two passages contained two nearly identical paragraphs followed mostly by dialogue. Both passages contained target phrases that did not vary or varied very little in their orthographic presentation. The paragraphs in both passages provided background information about the characters that appeared in the passage and contextualized the setting. Each dialogue consisted of a phone call between a character and her boyfriend. The girlfriend in Task 1 is named Seong-hwe and the girlfriend in Task 4 is named Young-mi. In both passages Seong-hwe is repetitively described as someone who lacks aegyo and doesn’t display a cute side to others, without actually stating the word aegyo itself in the passage. In both passages, Young-mi is repetitively described as someone who loves cute things, behaves cutely to her boyfriend, and frequently acts in a cute manner. Through the insertion of descriptors throughout the passages, including the phone call dialogue, the contrast between the contexts and differences between each character’s stereotyped personality was reinforced. For example, in sentences that contained target utterances, Young-mi was described as speaking in a cute voice whereas Seong-hwe was not. Therefore, it was expected that utterances that were orthographically written the same or as similar as possible would be read aloud differently by subjects depending on which character they were reading. It was expected that utterances “said” by Seong-hwe would elicit less aegyo than
utterances “said” by Young-mi. See Example 1 for samples of target sentences containing utterances forming contrastive pairs. In the passages, there were also utterances that were expected to have little or no contrast, either because the character voicing them did not change, or because they were identical sentences in both passages. From these sentences, five pairs were selected as control pairs.

The instruments used to collect data in Task 2 and Task 5 consisted of identical questionnaires that asked the participants to describe the personalities of Seong-hwe and Young-mi, and to summarize the plot of the passage. These two tasks were constructed to ascertain that the subjects understood the context information embedded in the passages. After the experiment, the responses were read and it was determined that all of the subjects had comprehended the passages. The instrument used to collect data in Task 7 was a questionnaire used to learn about participants’ demographic backgrounds.

Example 1

Examples of Different Paired Utterances Embedded in Task 1 and Task 4

Excerpts from Task 1 and Task 4 Containing Identical Utterances Contextualized to Contrast

<table>
<thead>
<tr>
<th>Task</th>
<th>Korean Orthography</th>
</tr>
</thead>
<tbody>
<tr>
<td>Task 1</td>
<td>“오빠!” 성희는 말했다. “나도 아이스크림 먹고 싶어!”</td>
</tr>
<tr>
<td></td>
<td>Identical  Non-Aegyo Context  Identical</td>
</tr>
<tr>
<td>(English Translation: “Boyfriend!” Seong-hwe said in a child-like voice. “I want to eat ice cream too!”)</td>
<td></td>
</tr>
<tr>
<td>Task 4</td>
<td>“오빠!” 응미는 아이 같은 목소리로 말했다. “나도 아이스크림 먹고 싶어!”</td>
</tr>
<tr>
<td></td>
<td>Identical  Aegyo Context  Identical</td>
</tr>
<tr>
<td>(English Translation: “[Boyfriend!]” Young-mi said in a child-like voice. “I want to eat ice cream too!”)</td>
<td></td>
</tr>
</tbody>
</table>

(Example continued on next page.)
Example 1 (continued)

Examples of Different Paired Utterances Embedded in Task 1 and Task 4

Excerpts from Task 1 and Task 4 Containing Similar Utterances Contextualized to Contrast

<table>
<thead>
<tr>
<th>Task</th>
<th>Korean Orthography</th>
</tr>
</thead>
<tbody>
<tr>
<td>Task 1</td>
<td>“혹시 저녁도 사주면 안돼?” 성희는 물었다.</td>
</tr>
<tr>
<td></td>
<td>Identical</td>
</tr>
<tr>
<td></td>
<td>Non-Aegyo Context</td>
</tr>
<tr>
<td></td>
<td>Similar</td>
</tr>
</tbody>
</table>

(English Translation: “Would it be possible for you to buy dinner as well?” Seong-hwe asked.)

Excerpts from Task 1 and Task 4 Containing Identical Utterances Not Contextualized to Contrast

<table>
<thead>
<tr>
<th>Task 1/Task 4</th>
<th>성희와 응미는 중학교 부터 친구 중의 친구였다.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Identical, Non-Aegyo Context</td>
</tr>
</tbody>
</table>

(English Translation: Seong-hwe and Young-mi had been the best of friends since middle school.)

Procedure

Participants received oral instructs to read the passages in Tasks 1 and 4 aloud in an entertaining manner, as though they were reading to a friend or family member. They were given a printed copy of the passages and recorded individually in a soundproof sound booth. Subjects were individually recorded with a Shure PG27 multipurpose side-address condenser microphone connected via a M-Audio MobilePRE USB Bus-powered preamp and audio interface to a desktop computer. During the recording, the speech produced was monitored and saved in a program called Wavesurfer. The raw data was recorded as WAV format in mono 16 bits at a sampling rate of 4410 Hz and then later transferred to a flashdrive and computer for storage and analysis. Later, clips
were made from the recordings using Audacity, a free audio editor. The format of the raw data was preserved. After subjects completed reading a passage in Tasks 1 and 4, subjects were handed printed questionnaires in Tasks 2 and 5. Participants were instructed to write a short response to each question. In Task 7, participants were instructed to fill out the questionnaire and ask the researcher if they needed clarification regarding any questions.

Experiment 2

Experiment 2 consisted of two tasks. In Task 1, subjects listened to clips and made judgments about whether or not they perceived a clip to be aegyo. The clips used in this experiment were made from Experiment 1 recordings. Task 2 consisted of a demographic questionnaire. It was hypothesized that utterances “said” by Seong-hwe would be judged to be non-aegyo by participants and conversely, utterances “said” by Young-mi would be judged to be aegyo.

Participants
There were two subjects, one male native Korean speaker and one female non-native Korean speaker (myself). Neither of the subjects had participated in Experiment 1 and both were 21 years of age at the time of the study. The male subject spoke standard Seoul dialect, had attended school in South Korea for 12 years, and had been studying and living abroad in the United States for the past two years. I studied Korean as a foreign language at Washington University for three years, as well as through a study abroad experience in Seoul. It should be noted that the possibility for biases influencing my judgment was high, as I had already heard the clips before my participation in the experiment.

Materials
The instrument used to collect data in Task 1 consisted of a response sheet. For each of the clips, judges used the response sheet to rate whether they considered a clip to be aegyo. The options for responses were limited to three categories, “yes,” “no,” and “unsure.” “Yes” meant that subjects perceived a clip to be aegyo, “no” meant that subjects did not perceive a clip to be aegyo, “unsure” meant that subjects were undecided on whether or not a clip was aegyo. The instrument used to collect data in Task 2 was a demographic information questionnaire, the same one used for Task 7 in Experiment 1.

Procedure
The experiment took place in a soundproof booth. For Task 1, the stimuli were compiled into a computer playlist before the experiment. During the experiment, the stimuli were presented to the subjects with headphones. The judges were not trained in any way or given guidance on how to determine if a clip was aegyo. Subjects were instructed to listen to each clip and then circle the label on the response sheet that they thought best fit the clip. The subjects were informed that they could request to hear a clip again. In Task 2, subjects were instructed to fill a questionnaire out and to ask the researcher if they needed clarification regarding a question.
RESULTS & DISCUSSION

Experiment 1

The hypothesis that a significant difference between utterances produced in contrastive contexts, engineered to elicit less or more aegyo, as reflected in the mean absolute slope of the utterances was investigated. Data collected from Tasks 1 and 4 was analyzed using Praat, a speech analysis program, to find the mean absolute slope values for each utterance. Then the average of each subject’s mean absolute slope values in semitones (st) was calculated. The results did not match predictions. It was expected that Task 4 utterances would have a higher mean absolute slope on average than Task 1 utterances. However, with the exception of Subject 3, there was a decrease on average (see Figure 1). The significance of the differences between the average mean absolute slope of Task 1 and Task 4 clips was analyzed by paired t-tests conducted in R, a free software environment for statistical computing, which found that the p-values for all subjects were all above the cut-off p-value of 0.05. It was accepted that there was no significant difference between the average mean absolute slope in Task 1 and Task 4 for all subjects. It was concluded that the performances of the subjects did not vary significantly in terms of the average mean absolute slope of the utterances they produced even when they were voicing different characters.

Figure 1

To test the hypothesis that there is a significant difference between aegyo and non-aegyo utterances as reflected in the pitch range of utterances, the pitch range in semitones of each clip produced by each subject was calculated using Praat. These ranges were then averaged by subject. The average pitch range of subject 1 in Task 1 was 13.08725 semitones (st) and 16.10125 st in Task 4. The average pitch range of Subject
2 was 20.76 st and 21.02025 st in Task 1 and Task 4, respectively. The average pitch range of Subject 3 was 13.112 st and 17.41 st in Task 1 and Task 4, respectively. Utterances from Task 4 that were constructed to elicit “more aegyo” had greater pitch ranges on average for all subjects than those utterances analyzed from Task 1 (see Figure 2). This result was expected. However, for all subjects, the significance of the result was not supported by a paired t-test. The p-value of Subject 2, 0.4636, was deemed too high and unacceptable. The p-values for Subject 1 and Subject 3, .08242 and 0.06463 respectively, were much closer to 0.05 but still not low enough to be accepted as strong support for the existence of a significant difference in the average pitch ranges of Task 1 and Task 4 utterances.

![Average Pitch Range of Subjects By Task](image)

**Figure 2**

To evaluate the hypothesis that there is a significant difference between aegyo and non-aegyo utterances reflected in the mean average pitch of utterances, the mean pitch above 100 hertz of each clip was determined using Praat. The average of all of the clips’ mean pitches in Task 1 and Task 4 for each subject was then calculated. The result was that there was a higher average mean pitch for all subjects in Task 4 than Task 1 (see Figure 3). Subject 1 averaged a mean pitch of 4.38 st in Task 1 and 6.21 st in Task 4. Subject 2 averaged a mean pitch of 18.41 st in Task 1 and 19.05 st in Task 4. Subject 3 averaged a mean pitch of 15.88 st in Task 1 and 16.84 st in Task 4. A paired t-test was conducted and it was found that the p-values for Subject 1 and Subject 3 were 0.003375 and 0.003482, respectively, and were beneath the cutoff p-value of .05. Therefore the t-test for Subject 1 and Subject 3 supported the original hypothesis that the average mean pitch of speech differs significantly depending on whether the context of the utterances read by subjects was constructed to elicit more or less aegyo in Task 4 and Task 1. The conduction of a paired t-test for subject 2 resulted in a p-value of 0.2877, unacceptable support for a statistical difference.
The fourth hypothesis was that there is a significant difference between less aegyo and more aegyo utterances that can be seen in the difference between qualitative measurements made using the Korean Tones and Break Indices (K-ToBI) transcription convention. To test this hypothesis, clips were first analyzed using Praat. For each utterance, the Intonation Phrase (IP)-final word was divided into its respective syllables. Then the pitch contour of the final syllable of each IP-final word, which is known as the IP-final boundary tone, was coded for using the definitions for IP-final boundary tones stated in the K-ToBI transcription convention manual written by Sun-ah Jun7 (see Figure 4 for an example of the Praat display view used during coding.)

**Figure 3**

Average Mean Pitch Above 100 Hertz of Subjects By Task

**Figure 4**

An Example Screenshot of the Display in Praat Used During Labeling of Utterance Boundary Tones (Clip 5Y)
In total there were 102 boundary tones coded for using K-ToBI. If we exclude the “control” pairs AN, BO, CP, DQ, and ER from the count then there were 72 boundary tones total; for each task, the boundary tones of 36 utterances were examined. It was expected that the utterances derived from clips A, B, N, and O would be rated in Experiment 2 as “aegyo” for both Tasks. Hence the boundary tones from the utterances taken from Task 4 clips and the utterances from clips A, B, N, and O were categorized as Aegyo. There were a total of 48 non-aegyo boundary tones whose IP-final boundary tones were examined and labeled. Pair CP and ER were declaratives and DQ was an interrogative. As none of the clips in Pairs CP, DQ, and ER were expected to elicit aegyo, they are included in the category Non-Aegyo in Table 1 below. There were a total of 54 Non-Aegyo utterances coded for. All nine of the boundary tones that have been classified in previous research, L%, H%, LH%, HL%, LHL%, HLH%, HLHL%, LHLH%, LHLHL%, were observed in the examined utterances.

<table>
<thead>
<tr>
<th>IP-Final Boundary Tone</th>
<th>Task 1</th>
<th>Task 4</th>
<th>Non-Aegyo (Clips from Pairs CP, DQ ER and Task 1 Clips)</th>
<th>Aegyo (Clips from Pairs AN, BO and Task 4 Clips)</th>
</tr>
</thead>
<tbody>
<tr>
<td>L%</td>
<td>9</td>
<td>7</td>
<td>21</td>
<td>8</td>
</tr>
<tr>
<td>H%</td>
<td>10</td>
<td>7</td>
<td>12</td>
<td>7</td>
</tr>
<tr>
<td>LH%</td>
<td>4</td>
<td>4</td>
<td>6</td>
<td>4</td>
</tr>
<tr>
<td>HL%</td>
<td>4</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>LHL%</td>
<td>6</td>
<td>6</td>
<td>6</td>
<td>9</td>
</tr>
<tr>
<td>HLH%</td>
<td>1</td>
<td>3</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>LHHL%</td>
<td>2</td>
<td>1</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>HLHL%</td>
<td>0</td>
<td>4</td>
<td>0</td>
<td>6</td>
</tr>
<tr>
<td>LHHLHL%</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>Total Number of Labels</td>
<td>36</td>
<td>36</td>
<td>54</td>
<td>48</td>
</tr>
</tbody>
</table>

While the most frequently occurring IP-final boundary tones for both Task 1 and Task 4 utterances was L% and H%, the number of occurrences of the different boundary tones for Task 4 utterances were more closely bunched together in terms of their dispersion (see Figure 5). Two tones, HLHL% and LHLHL%, which did occur in utterances from Task 4 did not occur at all in the Task 1 utterances. Except for these two tones, there were no boundary tones that were exclusive to a task or category. However, while these two tones only appeared in utterances that were expected to elicit aegyo, neither of these two tones were the mode for Task 4 or the category known as Aegyo. That is, HLHL% and LHLHL% boundary tones were observed with less frequency in comparison to other boundary tones. This implies that these two tones are not strong indicators for utterances spoken in an aegyo speech style. Overall the utterances categorized as Task 4 and Aegyo were richer in diversity of IP-final boundary tone types than the utterances categorized as Task 1 and Non-Aegyo.
Figure 5

The boundary tones of utterances expected to be perceived as aegyo and non-aegyo were very similar in the types of IP-final boundary tones they contained. This result may imply that the current K-ToBI system is insufficient for measuring the prosodic difference between aegyo and non-aegyo utterances or that the prosodic difference between aegyo and non-aegyo is not significant from the perspective of the K-ToBI transcription conventions used. For this study a clear pattern between aegyo and non-aegyo utterances could not be ascertained using the K-ToBI. Therefore, the hypothesis that the K-ToBI transcription convention could be used to demonstrate a prosodic difference between less and more aegyo utterances was not supported. Of course, there is also the chance that the analysis approach using the K-ToBI transcription system may have allowed for greater error than other data analysis approaches due to the fact that the K-ToBI convention relies on researchers to make qualitative judgments based on their impression of the visible pitch contour. If there had been more than one person coding the clips, there may have been disagreement or alternate observations leading to different results. With that in mind, the fact that only one person participated in the coding of the utterances and that the number of utterances analyzed was fairly small and drawn from only three different speakers should be taken into consideration.

The question arises then: what does the data annotated using the K-ToBI demonstrate? While it is not reasonable to generalize the norm for larger populations of native Korean speakers from this experiment alone, it is amenable to discuss the possibilities that the results of the K-ToBI transcription invite future studies to explore and question. For one, is it possible that there are or would ever be IP-final boundary tones exclusive to one speech style, as exhibited in the data of this study? The idea that there is a boundary tone that is exclusive to aegyo seems unlikely. For example, a linguistic feature that marks a speech style may be used less frequently in favor of another feature that also marks the same speech style. Therefore, it is possible to mark a speech style through a variety of means. A single linguistic feature may be associated with different speech styles in different contexts and the features that mark a speech
style vary in usage by person depending on the context. It would be surprising if an IP-final boundary tone was exclusive to aegyo and universal among speakers. However, it seems plausible that there are boundary tones that are associated with aegyo more than with other speech styles. It seems likely then, that it would be possible to find out which tone or tones occur most often if the tones of a larger number of utterances by a larger number of participants were analyzed using the K-ToBI. A pattern may emerge in a larger study that could not be seen in this study.

Experiment 2

RESULTS
The recordings attained in Experiment 1 were made into clips, each containing one or more utterance. There were 78 clips in total; 26 clips (containing identical or similar utterances) were made from the recordings of three subjects from Experiment 1. These are the same clips that were analyzed to test the hypotheses discussed above. Out of the 78 clips judged there were 64 cases of agreement and 14 cases of disagreement between the judges. The subjects agreed 82.05% of the time in their perception of a clip as “aegyo” or “non-aegyo” (see Table 2). The estimated weighted kappa value for the level of agreement between judges was 0.80. This value indicates that the level of agreement between the subjects was substantially high.

Table 2
Descriptive Statistics for Experiment 2 Judging Task

<table>
<thead>
<tr>
<th>Agreed</th>
<th>Disagreed</th>
<th>Percentage of Agreement</th>
<th>Percentage of Disagreement</th>
</tr>
</thead>
<tbody>
<tr>
<td>64</td>
<td>14</td>
<td>82.05</td>
<td>17.94</td>
</tr>
</tbody>
</table>

Out of 78 total clips listened to by the judges, 29 clips were labeled by one or more of the judges against expectations. Based on the construction of the passages and the contextualized information given via instructions to Experiment 1 subjects before recording, it was expected that clips A, B, N, and O would be rated as “yes” or “unsure,” clips C, D, E, P, Q, and R would be rated as “no” and that the remaining clips would be rated as “yes.” The hypothesis that clips derived from the recordings made in Experiment 1 would be perceived (and thus rated as) aegyo, was met in many of the expected cases, implying that the construction of the Experiment 1 stimuli was at least somewhat successful in eliciting aegyo. It was expected that some clips would not be perceived as aegyo by one judge and might be perceived as aegyo by another judge due to the subjective nature of perception and the varying definitions of aegyo that subjects might have had. The high but not perfect level of concordance between judges was satisfactory, and some instances of ratings that went against expectations were anticipated.
CONCLUSION

As there are few scholarly linguistic studies in English about aegyo to date, it is my hope that this study will prove useful to those interested in aegyo. However, while the results of this study may be informative, they cannot be extrapolated to a larger population. For example, individual differences that might have “averaged” out in a larger study were strong due to the small sample size of this study. Ultimately, this study has remained beneficial in exploring some of the variables that may mark the aegyo speech style.

The fact that the clips were perceived as aegyo or non-aegyo as predicted by both of the Experiment 2 subjects in the majority of cases suggests that the instruments used in Experiment 1 were successful in eliciting the divergent speech styles. Of the three variables quantitatively analyzed and one variable qualitatively examined, there was only one variable, mean pitch, which varied significantly depending on the context. Due to the lack of significant difference between the variables investigated, one hypothesis that came out of this study is that an additional unexplored variable, or a combination of multiple variables, may play an even greater role than prosody in marking aegyo. The variables tested in this study were not an exhaustive list, and other variables, such as duration, nasalization, and palatalization, may also be indicators of aegyo.

Another reason why this study may be limited in its usefulness is its design. The linguistic possibilities that could have been explored through a different research design were curtailed in this study. In Tasks 1 and 4, passages were modeled after the stereotypical contexts that I had been exposed to in Korean media, and therefore were susceptible to my own biases. Also, context information was constructed to attempt to elicit only one type of aegyo, cute and child-like aegyo that is used between two people who are romantically related. However there are a variety of contexts for the use of aegyo, and further research should be conducted giving more attention to other varieties of the speech style in different contexts. It cannot be ignored that the results of this study may not occur in a “natural” environment, outside of the lab. Inevitably, the “hand” of the researcher designing the experiment instruments had some impact on the behavior observed.

Other factors that may have limited this study’s applicability to larger populations were that all of the subjects were current or recently graduated college students, were close in age, and had experience studying one or more foreign languages and had studied abroad. The similarities in performance among the subjects in Experiment 1 and Experiment 2 may not have been found in a subject pool with different occupations, ages, and educational backgrounds. While the applicability of this study to other populations seems small, it still holds great insight for the small population it sampled from. And as Coupland asserts such findings may have been “lost” or “overlooked” in a study of greater size. Further studies must be conducted in the future to help build a more comprehensive understanding of aegyo.

Notes

defined as “남에게 귀엽게 보이는 태도.” I translated “태도” as meaning “manner or attitude”.


6 Ibid. Page 153.


10 The clips from Pairs AN, BO, CP, DQ, and ER were not included in the calculation of the mean absolute slope, pitch range, or mean pitch because they were control clips which were expected to elicit similar if not the same result in both tasks. All other clips, due to the fact that they were “said” by Seong-hwe in Task 1 and contrastively by Young-mi, whose cuteness was emphasized in Task 4, were expected to elicit different results and thus were used for analysis.


12 Some clips contained more than one utterance. For each utterance the IP-final word was divided into syllables. Then the IP-final syllable was coded for. Each utterance and their respective K-ToBI label, rather than each clip, was counted individually for Table 2.

12 For example, another bias in the script was that the dialogue from which contrastive utterances were drawn took place between a girl and her boyfriend in each task. Furthermore, non-gender neutral words such as “oppa” (meaning literally older brother but boyfriend in this context) were used to emphasize the relationship between the girl and her boyfriend. It may be that subjects (unconsciously) attempted to speak in a manner that they thought best resembled their prototypical idea of how a female would act toward a male. Subjects may have also spoken in a manner that they thought best fit how any gendered person would act towards a male. However, it seems unlikely that subjects would have spoken in a way that they thought best fit the behavior of a male who was speaking towards a male. And of course other relations, such as a female speaking with a female, were unlikely to occur due to the construction of the passage and the context clues embedded. Therefore, it is impossible to ascertain if this data on aegyo fits other contexts as well.

14 Coupland writes: “Styling is part of the make-up of public as well as private discourses, and there is no overarching need to restrict sociolinguistics to sampling the speech of ‘ordinary folk’. Whichever speakers we settle on as informants—for a wide variety of reasons—the individual case needs to be addressed as well as the general tendency. This because aggregation rounds down our understanding of stylistic processes. It often blurs the potential for analytic insight. Single-case analyses are more likely to allow an adequate sensitivity to context and contextualization, where we can come to understand what the styling of variation can achieve. There is the possibility of generalizing from single-case analyses, but it involves generalizing to what is stylistically possible, rather than to ‘what people typically do” (27-28).
Toward a Better Understanding of...

Secessionist Spaces and Nigerian Identity

Oluwakemi Aladesuyi

Mentor: Timothy Parsons

Fela Anikulapo Kuti: “he-who-holds-death-in-his-pocket,” the father of “Afrobeat,” the “Black President,” “Chief Priest Say,” was a prominent Nigerian musician and activist in the 1970s-1980s. The impact of Fela’s music—its subversive and revolutionary undertones, its lyrics about a pan-African identity and political corruption—still reverberate within a wider discourse of popular music, political culture and post-colonial identity. Fela, an organic intellectual of the urban disenfranchised, used a variety of spaces as sites to contest a new Nigerian culture. This research explores how Fela performed identity through his use of space in his venue the “Afrika Shrine” and the secessionist commune he established in Lagos, the “Kalakuta Republic.”
Modernity, as represented through the literary modernism of Virginia Woolf and Nella Larsen, can be thought of as a new way of experiencing “experience,” one that denotes the categorization of identity with inner consciousness as well as exterior fact. Thought experience is as important as the material facts of existing—if facts are defined as those material reflections of how we imprint ourselves upon the world. How does our consciousness of ourselves define what happens to us and how we act? Can we exist as unified selves once we recognize an internal–external, objective–subjective division? In this thesis, I argue that Woolf and Larsen’s explorations on gender, while falling within the modernist representation of text-as-experience, problematize the dualist possibility of a unified self.

This analysis of Woolf connects her to a unified double consciousness of gender; that this particular expression of gender is consistent with modernist sensibilities of duality that reflect external and internal experience; and that Orlando is a strong case study to use in documenting and problematizing Woolf’s essential paradox—that a consciousness can be unified and divided simultaneously. I also argue that Larsen is not so accepting of the prospect of a unified internal–external experience. The women in Larsen’s novels—because of the necessity of negotiating around the caricatures of the tragic mulatto literary tradition—remain complicated, divided selves.

This work is an attempt to examine why and how Woolf and Larsen scrutinize the modernist representation of a dualist experience, and the importance of their explorations of gender as demonstrating divisions of identity.
The synthesis of N,N’-diacetic acid-2,11-diazo[3.3](2,6) pyridinophane (N4AcOH2; Dimer) and N,N,N’-triacetic acid-2,11,20-triaza[3.3.3](2,6)pyridinophane (N6AcOH3; Trimer) was optimized to produce better yields through different synthetic pathways than previously performed. The identity of the final product and each of the intermediate compounds part of the synthesis was verified with H-NMR, C-NMR, and low-res mass spectroscopy. Mononuclear complexes were formed with lanthanides while both mononuclear and binuclear complexes were observed with first-row transition metals. The identity of these complexes was verified with low-res mass spectroscopy as well as UV-vis spectroscopy. Recrystallization for x-ray crystallography is proving difficult so various methods for recrystallization are being investigated. Further studies such as fluorescence, oxidation and reduction, and elemental analysis will be performed on the synthesized complexes.
It has been well established that opioid receptor signaling plays a major role in the regulation of stress, pain, depression, and the rewarding properties of drugs of abuse such as morphine, nicotine, and cocaine. Although the Kappa opioid receptor (KOR) and Mu Opioid receptor (MOR) have been a key focus of narcotic research, knowledge is still limited on how the G-protein coupled receptors signal and yield behavioral responses. Study of specific brain regions and neural circuits can be difficult as the synthetic drug compounds diffuse throughout the brain with little spatial or temporal control. Thus, opto-genetic receptor constructs, activated by site specific laser activation, will provide a useful tool in the study of opiate cellular signaling mechanisms. We created a novel opto-genetic tool and molecularly characterized this chimeric receptor which uses rhodopsin light-sensitive activation machinery but results in opioid receptor signaling. Characterization of these receptors will result in a better understanding of the similarity between the native opioid receptors and the new optically activated constructs’ downstream signaling for \textit{in vivo} behavioral studies. In addition, our studies will work to better define native opioid receptor signal transduction, effects on cell biology, and neural systems. Optimization of OMOR and OKOR activation protocol will elucidate the G-protein and arrestin-mediated signaling time points at which protein kinase and adenylate cyclase activity is turned on, and how arrestin-dependent MAPK is initiated. We also characterized the length and intensity of light (efficacy) stimulation necessary to elicit a peak response, and calculated the power (dose-response) curve for each construct. This pharmacological characterization of a novel tool side-by-side with native opioid receptors for will provide valuable information when the tools are implemented for \textit{in vivo} neural circuit dissection studies in drug addiction, depression, pain and stress behaviors.
The Production of Safranal, Picrocrocin, and Crocin in *Synechocystis* sp. PCC 6803 and *Escherichia coli*

Brian Basco, Caleb Ford, Andrew Ng, and Ang Tony Xu

Mentor: Joseph Jez

The current WashU iGEM project focuses on the biosynthesis of the chemicals that are characteristic of the expensive spice saffron. Saffron is highly valued as a spice that adds unmatched flavor, aroma, and color to food. This spice has recently been identified as a potential treatment for diseases ranging from cancer to depression. Unfortunately, the natural form of saffron can reach thousands of dollars per pound due to low yield and the labor-intensive harvesting process. A project was designed to synthesize three chemicals which compose a significant portion of the aroma and coloration of the spice saffron: safranal, picrocrocin, and crocin. *Synechocystis* sp. PCC 6803 was chosen as the chassis for production of these compounds because of its photosynthetic nature and native production of the substrate, zeaxanthin. It was proposed that the two genes, ZCD and UGTCs2, would be sufficient to make the compounds in this organism. ZCD—native to *Crocus sativus*—cleaves the ends of zeaxanthin into crocin and hydroxyl-β-cyclocitrall. These products are then acted on by UGTCs2, to produce our products: safranal, picrocrocin, and crocin. Before attempting to generate these genes in *Synechocystis*, ZCD and UGTCs2 were cloned into *E. coli* in conjunction with the genes necessary to produce zeaxanthin. ZCD was successfully cloned into *E. coli* with the aid of a fusion protein to minimize the presence of inclusion bodies. This result was confirmed by SDS-PAGE followed by trypsin digestion and LC-MS/MS. A flux balance analysis model was also written to predict the optimal conditions for *in vivo* production of the three target compounds in *Synechocystis*. It is hoped that with this groundwork laid, future work can produce a biosynthetic alternative to saffron.
Animals acquire proper behaviors to survive, to mate, and to reproduce. Sensation of the surroundings tunes animal behaviors for optimal outcomes. We are interested in how external information is integrated by the neuronal network to promote animal decision and behavior.

*Caenorhabditis elegans*, a round worm with only 302 neurons, is capable to modulate behaviors in response to stimuli such as chemicals, light and mechanical forces. Here, we discovered that *Caenorhabditis elegans* is able to differentiate various environments based on spatial information, e.g. worms are highly enriched in areas with dense objects. This enrichment is achieved by reducing forward movements when entering the preferred area, as well as by enhancing the returning behaviors after leaving the area. We found that mechanosensation defective mutants have significant reduction in enrichment. In particular, removal of a stretch receptor (TRP-4) completely diminished the enrichment. This data suggests that body stretch is the driving force for worms to choose where to stay. Finally, the neuronal mechanism for worms to decode spatial information may be actively evolving, as wild isolates (the Hawaii strain vs. the Bristol N2 strain) make different decisions when facing spatial choices. Our current hypothesis is that the diversified behavior between N2 and Hawaii strains arises from a polymorphism in the stretch receptor TRP-4.
Parents and peers significantly impact children’s eating and activity patterns, as well as their perceptions about body image and weight. However, little is known about the role of parental and peer influences among treatment-seeking overweight and obese youth. The present study focuses on 1) synthesizing the literature on parental and peer effects of overweight youth, 2) characterizing the networks of treatment-seeking overweight children (e.g., network size, type of relationships including parents and peers), 3) assessing associations between network variables and demographic factors (e.g., gender, race/ethnicity), and 4) evaluating the associations between network variables and baseline degree of overweight. We are currently conducting a trial of family-based treatment for childhood obesity, and have collected baseline data of treatment-seeking children (N=241), including social network variables (via structured interview), demographic variables (via questionnaire), and degree of overweight (via weight and height calculations). Results of the literature review as well as analyses of the role of social network variables will be presented. Findings have the potential to identify risk and resilience factors related to parental and peer influence that are associated with children’s degree of overweight.
Antimicrobial drug resistance in many of the world’s most dangerous pathogens, including Gram negative bacteria, mycobacteria and the malaria parasite *Plasmodium falciparum*, drives a constant search for novel drug targets. The metabolic pathway that synthesizes isoprenoids holds considerable promise as such a target. By the 1990s, it was known that most eubacteria and plants make use of a linear pathway, the non-mevalonate pathway, which is biochemically distinct from the mevalonate route of humans. Curiously, however, there exist homologs of a single non-mevalonate enzyme, methylerythritol phosphate cytidyltransferase (IspD), in the genomes of zebrafish, mice, humans and many other eukaryotes. Since such organisms do not use the non-mevalonate pathway, it is unclear what role mammalian IspD (mIspD) has, or if small-molecule inhibitors of microbial IspD could result in off-target effects. Furthermore, recent research shows that mutations in human IspD (mIspD) are linked to Walker-Warburg syndrome, a form of muscular dystrophy, and result in reduced O-linked glycosylation of the important membrane protein dystroglycan. The interrupted step is the initial mannosylation of a serine or threonine residue. Since mIspD has homology to nucleotidyltransferases, we hypothesize that IspD activates mannose-1-phosphate with a guanosine nucleotide for mannosylation. Given the severity of human mIspD mutations, mechanism-based toxicity of microbial IspD inhibitors is a real possibility. This project aims to characterize the biochemical function of mIspD in humans, providing an important counter-screen in the development and testing of small-molecule inhibitors that target microbial IspD.
Contraceptive use in urban Ghana has been covered extensively by public health and anthropology scholars looking to document and analyze the beginnings of the West African fertility transition. Significant attention has been directed towards the gendered socialization of adolescents, condom use in rural and urban populations, and the contraceptive use practices of married men and women, but there is a gap in the literature on the ways that collegiate populations come to understand the varied hormonal and barrier contraceptive methods available to them.

This work seeks to develop an understanding of the gendered strategies that men and women enrolled at a major university in urban Kumasi use to broach the socially taboo topics of sex and sexuality. I conducted fieldwork at the Kwame Nkrumah University of Science and Technology under the auspices of the campus’ chapter of Planned Parenthood of Ghana (PPAG). Fifty individuals, including thirty currently enrolled university students, were interviewed about their views on contraceptive use. I also spent time observing at the PPAG clinic and analyzed popular media, including billboards, newspaper articles, and commercials, as well as PPAG’s promotional material.

Preliminary analysis of the data suggests that students view contraceptives in a highly oppositional gendered light because of Ghanaian social mores, and that these burgeoning understandings are highly shaped by popular media, which introduces non-specific messages about contraceptives that are meant for married or partnered couples. Because Ghanaian university peer groups are primarily single-gendered, both men and women rely on hearsay and rumors to construct their perceptions of the other gender’s views on contraceptives, which creates distinct gendered narratives on contraceptive decision making that align with traditional values but differ greatly from the displayed knowledge of each group.
There is accumulating evidence that systemic signals, such as inflammatory cytokines, can affect hematopoietic stem cell (HSC) function. Granulocyte colony stimulating factor (G-CSF), the principal cytokine regulating granulopoiesis, is often induced in response to infection or inflammation. Additionally, G-CSF is the most commonly used agent for HSC mobilization prior to stem cell transplantation. Recently there has been a renewed interest in the use of “G-CSF primed bone marrow” for stem cell transplantation, so understanding the affect of G-CSF on bone marrow HSCs is clinically relevant. Because the G-CSF receptor is expressed on HSCs, and G-CSF creates biologically relevant modifications to the bone marrow microenvironment, we hypothesized that increased signaling through G-CSF may alter the repopulating and/or self-renewal properties of HSCs.

Due to G-CSF’s role as an HSC mobilizing agent, we predicted that the number of HSCs in the bone marrow would be reduced after 7 days of G-CSF treatment. Surprisingly, we observe that stem cell numbers markedly increase, regardless of their immunophenotypic identification. To assess HSC repopulating activity, we conducted competitive bone marrow transplants. Compared to untreated HSCs, we found that G-CSF treated cells have significantly impaired long-term repopulating and self-renewal activity in transplanted mice. As HSC quiescence has been positively associated with repopulating activity, we analyzed the cell cycle status over time of KLS-SLAM cells treated with G-CSF. This analysis revealed that after a brief period of enhanced cycling, HSCs become more quiescent.

To identify targets of G-CSF signaling that may mediate loss of stem cell function, we performed RNA expression profiling of sorted KSL-SLAM cells. The profiling data show that G-CSF treatment is associated with activation of inflammatory signaling in HSCs. Studies are in progress to test the hypothesis that activation of specific inflammatory signaling pathways mediates the inhibitory effect of G-CSF on HSC function.
On October 22, 1876, William Henry Welch, an impressionable young American in Germany wrote to his father, “The law of evolution has steadily gained ground and is no longer contended against in the scientific world.” The intellectual climates of Germany and America were very different at that time. The intense evangelical American opposition to Darwinian materialism might be enough to make this case interesting. The case becomes much more interesting when we consider Welch’s childhood and what he was to do during his life.

William Welch grew up absorbing the Calvinist rhetoric of the American North-East. While he was attending the bastion of Calvinism, Yale University, he wrote two essays espousing Darwinism and the positivist, materialist philosophy it depended on. He claimed that this philosophy was needlessly harmful to both religion and society.

When Welch returned from Germany, he became the first professor of medicine at the newly formed Johns Hopkins Medical School. While at Hopkins, his influence was immense. By the time the first students came to Hopkins in 1886, Welch was considered the premiere American pathologist. Over the next 50 years, he had his hand in training almost every influential American physician in the first half of the 20th century. He was the designer of many of America’s medical reforms.

In this project, I will provide some of the context for Welch’s comments at Yale University. I analyze the development of his scientific mind, and the context of his conversion to Darwinism. While not presently completed, I plan to explore Darwinian influences in his immunology and pathology theory c. 1890-1920.
Toward a Better Understanding of…

SYNTHESIS AND CHARACTERIZATION OF COBALT-HEIDI CLUSTERS

Allison Brenner

Mentor: Darren Johnson, University of Oregon

The Johnson lab has previously synthesized Al_{13} and Ga_{13} clusters for use in thin films. Attempts are currently underway to synthesize similar high order clusters from first row transition metals using H_3heidi as a stabilizing ligand. Previous work has shown the successful coordination of H_3heidi to Fe, Ga, and Al, but structures with other metals such as Co have not yet been accomplished. The work herein describes the synthesis of cobalt-heidi complexes as well as their structural characterization with a series of techniques not previously used.
Toward a Better Understanding of...

**In Vivo Study of the Effect of iPLA$_2$ Gamma KO on Neointimal Formation after Overstretch Injury to the Carotid Artery (Surgical Aspects)**

*Christopher Brenner*

Mentor: Dana Abendschien

The objective of the carotid artery overstretch injury research was to assess the activity of calcium independent phospholipase A2 gamma (iPLA$_2$$^\gamma$) on vascular remodeling in order to better understand the effects of inflammatory processes. Recent research has shown that cardiac endothelial cells isolated from wild-type mice produced higher levels of both inflammatory arachidonic acid and anti-inflammatory prostaglandin I$_2$ (PGI$_2$) after protease-activated receptor (PAR) stimulation, compared to cells isolated from mice made deficient in iPLA$_2$$^\gamma$ (KO). Thus, a reduction of PGI$_2$ release *in vivo* in iPLA$_2$$^\gamma$-deficient mice may contribute to an increase in neointimal formation after vascular injury, while decreased production of arachidonic acid would decrease neointimal formation. To simulate injury induced by angioplasty and stenting of the coronary arteries in human patients, a beaded probe was inserted into the carotid arteries of anaesthetized wild type and iPLA$_2$$^\gamma$-KO mice. The external carotid artery was isolated and a beaded probe was inserted and passed retrograde three times into the common carotid artery. Although a myriad of technical issues were encountered, continuous efforts were made to perfect this type of high risk surgery and achieve valuable results. In essence, the probe overstretched the artery resulting in breakage of the internal elastic lamina and denudation of the endothelium mimicked balloon angioplasty. I hypothesized an overall reduction in the magnitude of neointimal thickening in the iPLA$_2$$^\gamma$–deficient mice, and the results are forthcoming. Further research will examine the possible beneficial effects of this type of deficiency in diabetic mice, and test whether this specific enzyme modification could be helpful in the prevention of excessive neointimal thickening during diabetes.
We are studying the nuclear decays of states in $^{13}$O $E^* = 3.03$ MeV and $3.68$ MeV, $^{13}$N at $E^* = 15.02$ MeV, and $^{12}$C at $E^* = 16.1$ MeV. We determined that the two states in $^{13}$O undergo two sequential steps of proton decay. The state in $^{13}$N $E^* = 15.02$ MeV undergoes decay through the state in $^8$B $E^* = 2.345$ MeV and sequential $p + \alpha$ decay through multiple states in $^{12}$C. The state in $^{12}$C at $E^* = 16.1$ MeV breaks up into 3 $\alpha$ particles. We are determining whether the 3-$\alpha$ particle decay of the state in $^{12}$C was sequential or simultaneous. The study of these nuclei provides information about reaction paths for stellar nucleosynthesis. These data also allow for comparisons to be made between levels in different nuclei with the same quantum structure where the role played by one of the protons is interchanged by a neutron or the reverse. Such states are called analogs. Comparisons of the relative energy provide information on the degree to which isospin is a good quantum number.
To minimize scattering and absorption of photons in deep tissues while increasing the penetration depth, we explored the feasibility of imaging in the previously unexplored extended NIR spectral region at 900-1600 nm. This region, also known as Optical Window II, is weakly dominated by absorption of water and free from other endogenous chromophores, leaving this spectral range absorption transparent with virtually no autofluorescence. To investigate the applicability of the Optical Window II in bioimaging we build a scanning imager featuring a fiber-optic based, linear-diode array with a detector aligned with a broad light source in transmission geometry. Based on the differences in depth penetration of photons with various energies in the tissue, we developed an algorithm for processing the acquired 3D “datacube.” The obtained images of a mouse head revealed sufficient resolution and anatomical structures consistent with the anatomy of the mouse brain. The potential of contrast enhanced imaging using optical contrast probes absorbing and emitting in extended NIR range is also discussed.
Brienomyrus brachyitus is a species of weakly electric fish that releases pulses of electric discharge (EOD) at varying rates measured as inter-pulse intervals (IPI). This is used for electrolocation and social behavior. While it is known that EODs are specific for species and gender and can be used by the fish to recognize conspecifics, it is unclear if the fish use IPIs for anything other than coding communication patterns. To begin testing the hypothesis that B. brachyitus can use IPIs to distinguish between individuals, threshold responses to six pre-recorded stimuli and five variations of them were recorded. The five variations were Random, Time Reversed, Jitter 1ms, Jitter 3ms, and Jitter 5ms. Of these, the difference in response threshold was significant for Random, Time Reversed, and Jitter 5ms; all of these required a higher playback intensity than the original stimulus to evoke a response from the fish. This begins to point to the fact that B. brachyitus can recognize differences in the IPIs of presented stimuli and, therefore, may be able to use this information to distinguish individuals.
This research explores the activism and community-building efforts of South Asian American queer (LGBTQ, etc.) youth. The central question asks in what ways are organizational efforts for queer South Asian American youth successful (or unsuccessful) in helping them negotiate multiple identities and alleviate both homophobic forces in South Asian American communities and racism in predominantly white queer organizations? What will investigating these efforts illuminate about queer intersectional identities and organizing?

The project is an ethnographic study, focusing on the work of the South Asian Lesbian and Gay Association (SALGA) in New York City. Through interviews with youth involved (or intentionally not involved) and various staff members at the organization, I aim to understand exactly how these organizations address issues of intersectional oppressions, and what the work of these organizations says about South Asian American queer youth identity.

The research question is situated at the intersection of a number of issues: globalization, intersections of identity, and ethnic authenticity. As part of an emerging “global queer” movement, where activism for sexual minorities is occurring in various parts of the world, South Asian American queer organizations exist within the larger process of globalization. I seek to understand the effects of globalization on identity, particularly queer identity and intersectional queer identity. The intersection of South Asian American identity and queer identity raises a number of questions about what it means to be “authentically” South Asian, as well as ways in which being of South Asian descent can affect the experiences of being queer in the United States. I hope to understand how these issues are, or are not, navigated through South Asian American queer organizations, and what these organizations can tell us about culturally-specific queer activism, ultimately transforming both queer activism and queer theory.
Alzheimer’s disease (AD) affects around 5.4 million Americans; one in eight older Americans has AD. One trademark of AD is intraneuronal neurofibrillary tangles of hyperphosphorylated tau. Tau is a microtubule-associated protein (MAP) mostly concentrated in the axons of mature neurons. Tau can be broken up into two isoform classes that have either 4 microtubule binding repeats or 3 caused by inclusion or exclusion of exon 10, respectively. Only 3R tau (without exon 10) is expressed during development in fetal brains, whereas adult human brains have a 1:1 4R: 3R ratio, and adult mice have almost exclusively 4R tau. In adult mice, 3R tau is found mostly in cell bodies of neural progenitor cells located in the SVZ and dente gyrus of the brain; 4R tau is found more abundantly in the axons of mature neurons. Research has shown that knocking out the endogenous tau in mice rescues AD-associated neurodegeneration in vivo, however, genetic knockout is not a feasible option in patients. Instead, antisense oligonucleotides (ASOs) can be used to knockdown or alter the splicing of tau mRNA, thereby controlling gene expression. Our lab is the first both to knockdown and to alter the splicing of adult mouse tau in vivo. We proposed that by infusing the ASOs into the bran, we could knock down and change the splicing of tau from 4R to 3R in mature neurons. We collected and performed immunofluorescence on knockdown and splicing ASO treated non-transgenic mouse brains. Major results include evidence that knockdown ASO treated mice have a significant reduction in total tau; while splicing ASO treated mice show a significant increase of 3R tau in mature neurons. This work supports the use of an ASO treatment as a potential therapeutic strategy for treating AD and for better understanding the role of 3R tau in the adult brain.
The cytoskeleton in neurons plays a key role in defining neuronal morphology and is related to human diseases, such as epilepsy, when disrupted. CSPR-1 (C. elegans homolog of human CAMSAP and drosophila Patronin) is a protein that we believe interacts with microtubules and stabilizes the cytoskeleton in neurons. We use Caenorhabditis Elegans mechanosensory neurons as a model system to study CSPR-1 because of the relatively simple anatomy and the nonessential nature of these neurons for viability. Previous study on Patronin suggested that it is a microtubule minus end binding protein and loss of Patronin results in damage to interphase and mitotic microtubule arrays. However, its interaction with the cytoskeleton in neurons remains unknown. We identified cspr-1(js1286) as a point mutation allele that showed aberrant neuronal branching morphology, which can be fully suppressed by decreasing the growing temperature to 15°C. We tested the branching morphology at different stages of development and found that cspr-1 mutants went through neuronal remodeling constantly throughout development. However, when grown at 15°C until the first larval (L1) stage and shifted to 25°C, cspr-1 mutants showed suppressed aberrant branching morphology phenotype, suggesting that CSPR-1 plays a larger role in branch formation instead of maintenance. To further explore the interaction between CSPR-1 and microtubules, we grew mutant animals on food spots with colchicine, a drug that slows down the formation of microtubules, and the aberrant branching morphology of cspr-1 mutants was enhanced, while the wild-type worms show no change in branching morphology. Our results suggested that CSPR-1 interacts with microtubules and stabilizes the cytoskeleton in neurons throughout development. Recent study showed that CAMSAP1L1, human homolog of CSPR-1, is a cytoskeletal protein, whose variance was recently shown to increase the susceptibility to epilepsy in Chinese population. Therefore, our study is important in helping to understand the pathomechanism of epilepsy by exploring the relationship of this gene with a disrupted cytoskeleton in neurons.
When an Influenza A virus of avian origin infects a mammalian species, it has the ability to genetically adapt or reassort with existing human influenza viruses, potentially creating novel pandemic influenza viruses. The 1918 pandemic with the H1N1 Spanish Influenza virus claimed 30 million victims worldwide. The viral determinants that allow an avian influenza virus to infect a mammalian host are not well defined. We have selected two avian influenza viruses for their ability or inability to induce morbidity and mortality in a small mammalian host (the DBA2/J mouse). Between these two avian viruses, A/shorebird/Delaware/22/06 (H7N3) and A/mallard/Alberta/177/04 (H7N9), H7N3 is extremely pathogenic and induces high morbidity and mortality in vivo. Also, H7N3 virus replicates faster in tissue culture compared to H7N9. The goal of our study is to identify the genetic residues in the genome of this H7N3 virus associated with the increase in pathogenicity. From previous experiments, we observed that the H7N3 virus with the H7N9 polymerase genes is attenuated in vivo, suggesting that the polymerase genes control in vivo pathogenesis. Of the three polymerase genes, the PB2 of H7N9 had a significant effect on survival after intranasal infection. With the focus on the PB2 gene, we investigated the 6 amino acids that differ between H7N3 and H7N9. Through site-directed mutagenesis, we created H7N3 viruses with single amino acid changes at those points of interest. One of these viruses, the PB2E358V is attenuated in vivo. Thus, residue 358 of the PB2 polymerase protein is associated with influenza pathogenesis and certain amino acid residues at this position may facilitate replication of avian influenza viruses in a mammalian host.
Effect of Metformin on Outcomes of Radiation Therapy in Oropharyngeal Cancer Patients with Type II Diabetes Mellitus

Re-I Chin

Mentor: Wade Thorstad

Metformin, a first-line drug of choice for treating type 2 diabetes approved by the FDA in 1994, has more recently demonstrated potential benefit against cancer in vitro, in vivo, and in humans. Although basic research and prevalence data indicate an association between metformin and anticancer activities, few studies have investigated the role of metformin in clinical anticancer treatment. Given some recent in vitro data suggest that metformin may be a radiosensitizer, we are interested in retrospectively examining the effect of metformin on the outcomes of radiation therapy. This retrospective cohort study focuses on patients with cancer of the head and neck, a major treatment site in radiation oncology, because no research thus far has examined metformin’s relationship to cancer of this region clinically.

This study reviewed the medical records of patients with cancer of the oropharynx, a subsection of the head and neck. To qualify for the study, these patients also needed to have been diagnosed with type II diabetes mellitus before the start of radiation therapy and have completed intensity-modulated-radiation therapy (IMRT) as a part of their treatment at Barnes-Jewish Hospital, St. Louis, MO. Analysis of the data collected is underway. Survival analysis, such as Kaplan-Meier curves, log rank test, and Cox proportional hazards model, will be used to examine the effect of metformin on the outcomes of radiation therapy, such as overall and disease-free survival, local/regional control, and distant metastases.
Toward a Better Understanding of...

Early Confinement in *Drosophila melanogaster*

Michelle Chung

*Mentor: Paul Shaw*

Sleep has been shown to be necessary for survival—long-term sleep deprivation has been shown to cause death in lab animals—and to help consolidate useful memory and prune unnecessary information gained during the day. A rough correlation has been shown between sufferers of trauma and other psychological conditions and either increased or decreased sleep, therefore we explored this connection through the use of the model organism *Drosophila melanogaster*, chosen because of its similarity to the human sleep cycle and fast reproduction. We identified a specific “type” of trauma, confinement, and tested to see if this would lead to an increase or decrease in sleep. In adult flies, there was no noticeable difference between control and confined Cantor-S flies. However, for young non-wing extended Cantor-S flies, confinement was found to lead to an increased amount of sleep compared to the control flies. The statistical significance of this increase has yet to be calculated; however, this data does suggest some evidence that trauma during a critical period in development does lead to increased sleep and further consequences in the future.
Muscular dystrophy is a progressive muscle weakness disease caused by mutations in various genes implicated in muscle cell function and homeostasis. A missense mutation in the nuclear matrix protein, Matrin-3, (S85C) causes distal myopathy type 2 (DM2) associated with vocal cord and pharyngeal dysfunction (VCPDM) in affected individuals. The VCPDM muscles are characterized by excessive muscle degeneration and nuclear lamina accumulation of Matrin-3. Matrin-3’s nuclear functions are associated with chromosome territory organization, DNA repair, and overall gene expression regulation. Recently, Matrin-3 has been found to bind directly nuclear lamina protein, Lamin A/C. Mutations in Lamin A gene trigger laminopathies characterized primarily by muscular dystrophy. Therefore, distal myopathy caused by S85C mutation of Matrin-3 and laminopathies may have a common myopathic molecular pathway. To investigate the myopathic role of S85C Matrin-3 mutation on the nuclear lamina and myogenesis, C2C12 myogenic cell line was transfected with S85C YFP Matrin-3 and studied 24 hours post-transfection in growth media or 48 hours in differentiation media. Lamin A/C and markers of differentiation such as myogenin and myosin heavy chain were studied by immuno-fluorescence. Mutagenesis of Matrin-3 cDNA was performed to generate the S85C Matrin-3 mutation. Final subcloning of Matrin-3 and S85C YFP are currently achieved. Reduced transfection efficiency was noted for both Matrin-3 and S85C compared to eYFP alone. A few Matrin-3 and Matrin-3 S85C eYFP positive nuclei were found in myotubes; these myotubes also expressed Lamin A/C, Myogenin and Myosin. This preliminary data suggest that the overexpression of Matrin-3 and Matrin-3 S85C may interfere with cell cycle, but surviving transgene positive myoblasts were able to fuse into myotubes and may express myogenic differentiation markers.
The research conducted reports a method used to characterize nanofilms coated with layers of alumina nanoparticles. The nanofilms were first coated with a layer of alumina nanoparticles and were then covered with a silsesquioxane layer that helped to make the nanofilms more durable. After alternating between these types of layers for a given amount of layers, the nanofilms were covered in a final layer of FOTS, a surface modifier that was used to make the nanofilms superhydrophobic. These nanofilms were prepared at different pressures and with different numbers of layers. Through the use of a water erosion test, we were able to test nine different films with different preparatory conditions. With this test in place, we were able to determine what the ideal number of layers and preparatory pressure should be in order for the superhydrophobicity of the nanofilm to remain after contact with water. The nanofilms tested were already considered oleophobic and the research conducted showed the ideal type of nanofilm for maintaining superhydrophobicity. The knowledge gained in this research was used to help the company Integrated Surface Technologies make a more informed decision on what nanofilms to use in hearing aid applications.
Hydrogen nuclear magnetic resonance was performed using a 200 MHz magnet on three palladium hydride (PdH\(_x\)) samples, prepared using palladium black powder and laboratory grade hydrogen gas. These experiments were used to measure the variation in the T\(_1\) spin relaxation time of each sample as a function of sample temperature. The PdH\(_x\) was observed to have a 6200 Hz Knight shift, which allowed for straightforward analysis of its T\(_1\). Using three different temperatures of preparation (21°C, 100°C and 200°C), the T\(_1\) values of PdH\(_x\) were measured across the temperature range of negative 140°C to positive 100°C. In general, the T\(_1\) values of the sample decreased with increasing temperature. Variation in the T\(_1\) values was also seen due to the different procedures for sample preparation.
Metabotropic glutamate receptor 5 (mGluR5) is a glutamate-activated, G-protein-coupled receptor that plays an important role in neuronal development, synaptic plasticity, learning, and memory. Recently, mGluR5 has been shown to oppose the Fragile X Mental Retardation protein, FMRP, which functions as an mRNA translational suppressor. Most studies so far focused on the role of cell surface mGluR5. However, up to 90% of mGluR5 is intracellular, located on either the endoplasmic reticulum or nuclear membrane. We have shown that active intracellular mGluR5 generates unique cellular responses in striatal neurons, inducing long, sustained Ca\(^{2+}\) responses leading to the activation of MEK-extracellular signal-regulated kinase (ERK1/2) pathways. Other signaling pathways downstream of mGluR5 activation implicate the mammalian target of rapamycin (mTOR) cascade, which controls initiation of cap-dependent translation. Growing evidence indicates that dysregulation of the mTOR signaling cascade is associated with human diseases, including cancer, diabetes, autism, and Fragile X Syndrome. Previously, the mTOR pathway studies have only examined the role of cell surface mGluR5; this study shows that both cell surface and intracellular mGluR5 lead to the activation of the PI3K-Akt-mTOR-S6K pathway in striatal neurons. In addition, eukaryotic elongation factor 2 (eEF2) which modulates the elongation step of protein synthesis is also phosphorylated by both cell surface and intracellular mGluR5. The focus of this research is an important mTOR and MEK target postsynaptic density protein 95 (PSD95), a scaffolding protein that forms clusters of receptors or ion channels at postsynaptic sites. PSD95 is upregulated by intracellular but not cell surface mGluR5 in striatal neurons. The mGluR5-induced upregulation of PSD95 is MEK-ERK and translation-dependent but PI3K-Akt-mTOR-S6K and transcription-independent. In summary, these studies suggest a major role for intracellular mGluR5 in the regulation of synaptic plasticity, and might lead to novel strategies for disorders such as Fragile X syndrome, anxiety, addiction, and Parkinson disease.
Rice (*Oryza sativa*) was domesticated in the Yangtze Valley, China, over 10,000 years ago from its wild progenitor *O. rufipogon*. Since then, *O. sativa* has evolved several important domestication traits, and has turned into the single most important food crop in the world, providing almost 20% of the world population’s calories. Weedy rice is an inter-fertile variant of cultivated rice that infests rice fields around the world, causing significant losses in yield and decreased market value of the crop. Phenotypic characteristics vary in the weed where some traits more greatly resemble the domesticated strains of rice, while others have clear phenotypic resemblance to wild variants. Genome-wide genetic divergence in weedy rice from the United States indicates that it most likely evolved via de-domestication (feralization) of crops before rice cultivation was brought to the U.S. While weedy rice in the U.S. has been well characterized both genetically and phenotypically, weedy rice from other regions of the world has been less extensively surveyed. A major focus of this project is to analyze the genetic and evolutionary influences that affect phenotypic expression and variability of weedy rice strains from Malaysia and Korea in order to better understand the complex evolutionary forces that have shaped this problematic weed. Phenotyping of Malaysian samples from the Sabah region revealed high trait variability among several phenotypic types, whereas the U.S. weedy rice seemingly only has two main biotypes. Additional data collection is beginning to reveal that the weedy rice is far more diverse than previously thought, and phenotype/genotype analyses continue to uncover new mysteries and insights into the evolution of these noxious weeds.
A radioisotope of cesium, $^{137}$Cs, has been widely used as a standard radioactive source because of its single 662-keV transition from the decay of an excited metastable state of the daughter nucleus, $^{137m}$Ba. However, it is theorized that the 662-keV gamma transition has the potential to occur via a two-photon process rather than via a single-photon process. The frequency of the two-photon process is thought to be on the order of once every million decays. Currently being conducted, the experiment is searching for the existence of this two-photon decay process and comprises of two groups of four LaBr$_3$:Ce scintillating detectors. Each group is housed in two copper cylinders, pointed at a $^{137}$Cs source approximately sixty degrees from each other, with a lead brick in between the two groups. By recording only coincidence data from the detectors, the detector array has a much better chance of finding the two simultaneous gamma rays (the energies of which would add to 662 keV). Furthermore, the lead brick substantially reduces Compton scattering of gamma rays between the detectors. Due to the rarity of the decay, a substantial amount of data is required for the experiment, thus the experiment will continue for several months to perhaps even a few years. With enough data, we are hoping to distinguish events with two primary photons from the decay of a single $^{137}$Cs from events where either the two photons are not from the same $^{137}$Cs decay or one-photon events where the single photon scatters from one detector to another.
Older adults (ages 55-75 years) were given a baseline cognitive assessment, which consists of a battery of memory and attentional control tasks, in order to determine their initial level of cognition. Then they were given aerobic exercise training, cognitive training, or a combination of the two followed by cognitive assessments over the span of one year to measure any changes in their cognitive ability. Tasks within the cognitive assessment, like the Prospective and Retrospective Memory Questionnaire, the Logical Memory task, and the Virtual Week game, address one or more of three important areas of cognition: prospective memory, retrospective memory, and task coordination. Data collection is ongoing, so preliminary analysis has not yet been conducted. Ideally, the results will support the hypothesis that a combination of aerobic exercise and cognitive training will have an additive effect on the maintenance, and potentially augmentation, of cognitive ability during old age.
In November 2009, the Swiss public voted to ban the construction of minarets across the country. Minarets are tower-like structures attached to mosques from which the call to prayer is projected five times a day. However, in non-Muslim majority nations, the minaret is not used to project the call to prayer, and is, instead, an architectural symbol akin to a church steeple. As only four minarets stand in Switzerland and none project the call to prayer, it is not self-evident why they pose a problem for the Swiss. This research examines the rise and the organization of Islam in Switzerland to understand the social and political structures which led to the minaret ban, and the effects of the ban on the Muslim community.

By examining the history of Muslim immigration into Switzerland and the demographics of the Swiss Muslim community, I have found that the Muslim population has immigrated from a number of different countries. As religion is intertwined with regional culture, a variety of different “Islams” exist within Switzerland, making it difficult for the Swiss government to understand how to incorporate this new population into their idea of “Swiss culture.”

I have found that these variations on Islam in Switzerland have led Muslims to organize according to country of origin. However, through a number of personal interviews I conducted with scholars, politicians, and Muslim practitioners, I found that Muslims have begun to congregate as Muslims instead of according to nationality, due to the way in which the minaret ban set Muslims apart. This shift in Muslim organization may lead Muslims to gain political agency, but it may also lead to “Muslim versus Swiss” sentiments across the nation.
The debate between consequentialism and non-consequentialism is one of the most important issues in contemporary normative ethics. It is fundamentally a disagreement over the structure of morality—is the status of actions as right or wrong to be determined by their (possible) outcomes, or by independent criteria? Due to the plethora of ways to specify which outcomes one ought to aim for, in recent years several authors have begun to discuss the scope and importance of a process called “consequentialization.” To consequentialize a given non-consequentialist moral theory M, one must make a new theory M* that has a consequentialist structure and yet reaches the exact same deontic verdicts as M. With this process in mind, a natural question is whether all non-consequentialist theories can be consequentialized in this way. The aim of this work is to clarify the motive, extension, and limitations of consequentialization. I first explain why this process is important for the debate between consequentialism and its rivals, and then go on to develop an axiomatic approach that provides a general account of the scope of consequentialization. Using this account I argue that one can consequentialize any remotely plausible moral theory, provided that the theory does not invoke the concept of value incommensurability. Thus the upshot of my argument is that the status of value incommensurability as a legitimate moral fact (or not) is a key fulcrum in the debate between consequentialism and non-consequentialism, and thus should be a focus of future discussions.
Toward a Better Understanding of…

Nuclear Magnetic Resonance Studies of Sodiumaluminohexahydride (Na₃AlH₆)

Tim Ellis-Caleo

Mentor: Mark Conradi

Many applications of modern physics require the investigator to understand the behavior of specific atoms in compounds. The behavior and structure of molecules such as sodiumaluminohexahydride (Na₃AlH₆) is relevant to the field of hydrogen storage. In this study, we used Nuclear Magnetic Resonance to examine the behavior of sodium, aluminum and hydrogen atoms in the compound sodiumaluminohexahydride. Sodiumaluminohexahydride consists of a covalently bonded AlH₆ anion that forms an ionic bond with a sodium cation. Particularly, we investigated the atomic motion at various temperatures by looking at the motional averaging of the atoms as a function of temperature from 23°C to 240°C. Atoms in motion will return results from the nuclear magnetic resonance experiments which are distinguishable from that atom when it is stationary. For example, the precise frequency of a ²³Na atom in Na₃AlH₆ depends on the orientation of the local hydrogen nuclear spins. From these results we can determine whether the atoms are in motion. Over this range of temperatures, our measurements are consistent with a model in which hydrogen atoms in the AlH₆ group rotate isotropically, while the sodium atoms diffuse through the solid. As the temperature increased, we saw evidence of increased sodium diffusion. We believe that the aluminum atoms are not moving and, though the hydrogen atoms are rotating, there is no translational component of diffusion.
Seven mice underwent a transplant surgery of the left lung. Four of these mice (170, 196, 199, 219) received no treatment after the surgery, allowing the mouse’s immune system to reject the new lung. The other three mice (171, 217, 218) received immunosuppression in the form of depletion of T-cells CD4 and CD8. All of the mice were imaged using proton MRI 3 days, 7 days, and 14 days post-operation. Analysis was then done on these images, focusing on the change in signal within both the transplanted and non-transplanted lung, along with measurements of compliance. Preliminary results show that usually the signal in the left lung increases greatly when left untreated (representing a rejection of the lung by the immune system), but that non-transplanted lung is relatively unaffected. The results all show that immunosuppression of the aforementioned type effectively stops the increase in signal (and therefore the rejection), at least up to 14 days after surgery. Results also show that the compliance of a failing transplanted lung decreases quickly, but also that the right lung’s compliance will occasionally increase in a seemingly compensatory manner.
Toward a Better Understanding of…

Identification of Intragenic Suppressor Mutations of ftsZ84

Ezinwanne Rosemary Emelue

Mentor: Petra Levin

FtsZ is a tubulin homolog that is essential for cell division in bacteria. It assembles into a ring structure at mid cell and recruits cell division machinery. The Levin Lab investigates FtsZ assembly and regulators of FtsZ ring formation. With this knowledge, parallels can be drawn to tubulin assembly in eukaryotes and a broader knowledge of bacterial cell division can be gained.

The main goal of this work is to identify secondary mutations in a temperature sensitive allele of FtsZ, ftsZ84, which restores ring formation and division in non-permissive conditions. We can then map these secondary mutations back to the FtsZ protein structure, and through a combination of biochemical assays we can further characterize the activity and assembly of these mutant proteins and learn more about FtsZ assembly.

To identify intragenic (in the ftsZ84 gene) suppressor mutations, E. coli with the ftsZ84 allele was grown at permissive conditions, and then plated at non-permissive conditions (No Salt (NS) media at 42°C) selecting for spontaneous suppressors of FtsZ84. Since ftsZ4 is located near a region containing a tetracycline resistance gene, I was able to use phage transduction to transfer these intragenic suppressor mutations into wild type E. coli. From this screen we found three suppressors (F39L, M206I, V293I) out of eighty-eight total cells screened. Twenty-six of these eighty-eight cells were found screened with the addition of ethane methyl sulfonate (EMS). Although the mutation rate was high (13 mutants out of 26 cells screened) all of the suppressors found using EMS were consistent in having the V293I mutation. Current and future directions include characterization of these suppressors through biochemical assays such as GTPase and light scattering assays.
Invasive shrubs and prescribed fires have similar and compounding effects on habitat characteristics. The removal of shrubs allows more sunlight to reach the ground, thereby increasing soil temperatures. Fires have the same effect on light attenuation and soil temperatures, in addition to increasing nutrient availability. Changes in these habitat characteristics often cause plants to alter their leaf morphology, making them more or less effective at photosynthesizing. We predict that removal of an invasive shrub and/or fires will change the leaf traits of co-occurring native shrubs, Buckthorn (*Rhamnus caroliniana*) and Spicebush (*Lindera benzoin*). During the dormant season of 2012, removal of honeysuckle and prescribed fires were applied to bottomland areas in Tyson Research Center. Each area had four plots: removal, no removal, removal and burning, and no removal and burning. Thickness, toughness, and area of sun leaves were measured during the following growing season. We found that fire significantly increased the leaf toughness of both buckthorn and spicebush. It also increased leaf area of spicebush. Removal of honeysuckle increased leaf thickness in spicebush, and had no effect on leaf thickness of buckthorn. There was no interaction of both removal and fire on leaf traits. We hypothesize that both fire and removal likely caused leaf traits to change because these treatments both affect soil drying. Furthermore, fire affects certain characteristics, such as toughness and leaf area, because the plants are top-killed and must resprout from the root crown. Changes in leaf traits should result in greater photosynthetic capacity as well as decreased water loss in stressful habitats.
Mucopolysaccharidosis VII (MPS VII) is an autosomal-recessive lysosomal storage disease that results from mutations in the gene that codes for the enzyme β-glucuronidase (GUSB). GUSB contributes to the breakdown of glycosaminoglycans (GAGs), and its deficiency causes an accumulation of GAGs throughout the body and multisystemic problems. It is believed that the accumulated GAGs bind to a cell-surface receptor that leads to signal transduction, which induces an inflammatory response that upregulates destructive proteases. This increased protease activity could be responsible for the fragmentation of elastin in the aorta, which causes aortic dilation and increases the risk of aortic aneurysms. The aortas of MPS VII mice are consistently 2 to 3 times wider than the aortas of normal mice. However, one colony of MPS VII mice from a mixed genetic background was found to have mice with dilated aortas and mice with non-dilated aortas. This observation suggests that the MPS VII mice with non-dilated aortas inherited a gene from an alternative genetic background that confers protection against aortic dilation. An initial screening showed approximately 7% genome difference between the pure MPS VII mice and the mixed genetic MPS VII mice. One hundred additional SNP markers were selected from the chromosomal regions with genetic differences, and a SNP assay was performed on 92 MSP VII mice from the mixed genetic background. We found significant associations between reduced aortic diameter and a 50 Mb chromosomal region at chromosome 1. In our search for candidate genes, we have found two IgG receptors, Fcgr2 and Fcgr4, in this gene rich region, which are upregulated in MPS VII mice with dilated aortas.
During Liberia’s recent civil wars, many women were victims and witnesses of gendered violence, sexual assault and rape. Women’s bodies became a platform through which violence took place: as the country was in conflict, the female body was a battleground. This project explores the attitudes and actions of young Liberians in their sexual histories and current relationships in light of this exposure to gender violence. Through an ethnographic study, I examine the extent to which the trauma of experiencing or witnessing gender violence impacts sexual relationships.

In general, the literature on the psychological consequences of sexual and gendered trauma does not focus on Liberia. This project, therefore, informs an area of academia where there is presently no conversation. Through this ethnography, I seek to give a voice to those underrepresented in the academic conversation. I plan to visit Liberia and conduct interviews and as I learn the thoughts and actions of young Liberians concerning their past and current relationships, I seek to determine if they follow the patterns described in the literature. What makes them unique, and how should the academic community adapt to this knowledge?

Some scholars of gender violence have highlighted how historical attitudes and beliefs about women created a situation in which gender violence can thrive. Gauging the extent to which these are relevant currently can shape the conversation about gender and sexuality. Cultural beliefs and actions can be better understood if it is known where ideas are birthed and how experiences with trauma change them. I seek to tie together information from the current literature and the words of those living the experiences in order to better understand how experience with gendered violence shapes the individual.
Eye Detection and Pupil Tracking for ALS Patients

Cameron Fleming and Thomas Powers

Mentor: Arye Nehorai

The goal of the pupil tracking project is to provide a method of communication using eye movement for people with Amyotrophic Lateral Sclerosis (ALS) who are unable to control voluntary muscle movement in their limbs. We use MATLAB in order to prototype the process of eye detection and pupil tracking. Eye detection has three main steps: region segmentation, homomorphic filtering, and circle detection. We segment the eye region of each frame by finding the pixel indices that maximize the horizontal and vertical projections of the image gradient. The maxima correspond to the regions of significant intensity changes along the edges of the face. The homomorphic filtering step improves the contrast of the segmented region by acting as a high pass filter. In the circle detection step, we use a Hough transform to detect circles in the segmented region to check if the region is a valid measurement. The detected circles also serve as initial estimates for the pupil tracking. In the tracking step, we use the histogram of the segmented region as a measurement, and employ a Kalman filter to track the exact pupil locations. We also focus on the real-time implementation to achieve processing speeds of fifteen frames per second, initially and thirty frames per second later on. Such high speeds are required to match the recording speed of the camera.
Complex changes in morphology occur in the chicken embryo during its early stages of development, and mechanical forces drive the movement of tissue in the embryo to create organs such as the brain, heart, and eyes. In particular, the mechanical forces that control the growth of the brain have not been fully quantified. Current methods for determining stresses and material properties of the embryonic brain are applicable to the organ only as a whole, whereas we wish to understand the mechanical forces in localized regions. To do so we use small magnetic beads, about 30 µm in diameter, which are placed on the chick brain. A permanent magnet is then used to apply a calibrated, localized force directly to the brain, and the displacement of the bead is measured with Optical Coherence Tomography (OCT). Finally, the mechanics and tissue properties of the brain can be obtained from the OCT images. Understanding forces that control development in chickens can help to understand development in humans, with the ultimate aim of helping to treat and prevent common neurological disorders such as autism and schizophrenia.
Toward a Better Understanding of…

**Soil Depth as a Factor of Stress Tolerance-Competition Trade-offs in Glade Specialist Plants**

*Stephen Fuller*

*Mentor: Tiffany Knight*

Predictions of species based on species-area curves have been essential to management and the field of conservation, but recent evidence suggests that not all ecosystems follow this curve. Observational research on plant communities in restored glade ecosystems in the Missouri Ozark region have shown a shallower species-area curve than would be predicted from larger habitats. One possible mechanism that might explain this pattern is that larger habitats might have more microhabitats and thus allows the persistence of a wide variety of species with different stress tolerance traits. Soil depth varies widely in glade habitats, and could be largely influential in water stresses on a plant. In order to study differences in stress tolerance as it relates to soil depth, 5 surveys of 9 plant species were taken over 5 plots of varying soil depth set up in a recently reseeded natural glade. Shallow soils are expected to be more stressful, so plant species with a higher stress tolerance are predicted to perform better in the shallow plots. On the contrary, due to stress tolerance-competition trade-offs commonly found in specialized plants, species that perform poorly in shallow soils are predicted to outcompete those species that perform well in shallow soils when given enough resources, in this case, deeper soil. The extreme drought of this past summer masked stress tolerance-competition trade-offs in 8 out of 9 species.
The complex interatomic structures observed in metallic glasses afford them a wide array of interesting and useful properties, but generally remain little understood. In this study, the structure of Cu_{46}Zr_{54} glass at room temperature was studied primarily via extended X-ray absorption fine structure (EXAFS) analysis. EXAFS was chosen due to its ease of data acquisition and the technique’s ability to differentiate among interactions between specific elements. A theoretical technique, Molecular Dynamics (MD) simulation, currently provides such information; however, it is limited in scope and requires exorbitant computation times in order to yield useful data. Proof of concept was obtained that EXAFS, in conjunction with X-ray diffraction and Reverse Monte Carlo simulation, can reproduce the results of MD simulations while requiring far less computation time. However, the power of this technique and the scope of its application are limited by a number of practical and theoretical factors. Inconsistencies in the theoretical replication of EXAFS data and experimental effects limiting the range of usable data remain some of the most significant issues, and must be the subject of further investigations.
Toward a Better Understanding of...

The Interaction of Religion and Spirituality in the Lives of HIV-positive Individuals

Sarah Gallo

Mentor: Shanti Parikh

With the introduction of highly active anti-retroviral drug treatment (HAART) in the mid-1990s, HIV/AIDS evolved from being a death sentence to a chronic disease in the minds of most Americans. However, this drug regimen can be extremely challenging to maintain and is not available with equal access globally. Additionally, HIV is still an extremely difficult disease to negotiate and significant emotional support is required to continue to fight the disease.

For many African-Americans, the church is an important source of such support, however given HIV’s origins in the gay community it has not been openly discussed in churches due to its taboo sexual connotation and few churches have resources available for their HIV-positive congregants. Nonetheless, like with most chronic diseases, spirituality and faith are one of the most common coping mechanisms among HIV-positive individuals. This research explores the ways in which personal spirituality and public religion interact in the context of HIV care for African-Americans in the St. Louis community.

This analysis of the current situation in St. Louis has been shaped greatly by ethnographic interviews with public health officials, religious clergy, and HIV/AIDS specialists in the non-profit sector as well as my observation at several local HIV-related nonprofits. As this research continues, I hope to begin to bridge the gap between the biomedical and spiritual components of care and better understand how disease is embodied in order to develop better approaches to caring for the whole person.
Toward a Better Understanding of...

**Rodent Predation Patterns in Restored Ecosystems Depend on Habitat Size**

*Cassandra Galluppi*

*Mentor: Tiffany Knight*

A general problem in the field of restoration ecology is that, when compared with large restorations, small restorations have fewer species than would be expected based on their area alone. There are many possible mechanisms, but one possibility is that plant-animal interactions might be considerably different on the edge of habitats, changing the overall strengths of these interactions in small habitats with a higher edge to area ratio than large habitats. Missouri Ozark glades are an ideal system to study this pattern: they have a defined edge where the desert-like clearing ends and the forest begins, they have many endemic species, and they are often the target of restorations. This experiment utilizes the large-scale experimental glade restoration at Washington University’s Tyson Research Center to test the hypothesis that rodent seed predation increases at the edge of the glades due to the cover the trees offer from aerial predators, leaving an island in the middle of large glades where seeds would not be subject to heavy predation. The area of this low-predation zone would decrease with decreasing glade area, so in smaller restorations, species introduced through seed might not be able to take hold in the habitat. This preference for edge habitat in rodent foraging behavior has been well-documented in natural systems, however, our results show that while the small glades showed no difference in predation based on tray location within the glade, the large glades showed more predation on the interior of the glade than the exterior, suggesting that the rodents could prefer to live in the large glades over the forest. This could be due to the flush of weedy species often present in early restorations: we suggest that management of these weedy species with fire or manual pulling is critical to reducing rodent predation and allowing plant establishment.
COPD (Chronic Obstructive Pulmonary Disease) results from chronic cigarette smoking or biomass exposure and is the fourth leading cause of death in the United States, but its disease mechanisms are still under investigation. In the Pierce lab we study highly characterized donor lungs and surgically removed lungs from patients getting a transplant for severe COPD. With the goal of identifying signatures or biomarkers in these lungs, gene expression profiling of COPD was done and, to further classify these genes, several subsets were distinguished. Since a subset of keratin genes indicated something interesting, this summer we focused on specific keratins commonly expressed at low levels in normal airways, but induced in the COPD specimens. Accordingly, we tested whether the gene expression profiling studies could be validated or further supported by doing Immunohistochemistry (IHC) and Real Time RT-PCR. Specifically, for assessing the expression of Krt6b and Krt17, we used Taqman assays (Invitrogen). From the IHC, we learned that keratin-17 amid other keratins is up-regulated in COPD airway epithelial cells in regions that look abnormal and with stacked up epithelial layers. Additionally, for a subset of Krt16 and Krt17, although their expression was increased in COPD specimens at the RNA level, localization by immunohistochemistry indicated a small subset of airway epithelial cells express these keratins which are often associated with a wound healing response. The importance of these genes is that they provide information for further analyses on the disease mechanisms.
Experimentalists have been discouraged from developing gamma ray lenses, as the number of lenses required for significant diffraction of gamma rays by Rayleigh scattering would almost completely absorb the incident rays. However, Habs, et al recently postulated that Delbrück scattering (the process of virtual pair creation) becomes significant at gamma ray energies, resulting in a positive index of refraction; high Z elements like gold would have higher indices of refraction at lower energies. This hypothesis is exciting because a practical gamma ray lens system would allow new radioactive isotopes to be used in medical imaging and could be implemented in gamma ray telescopes. To determine the feasibility of a gamma ray lens apparatus in the laboratory, a ray tracing program was created using basic optics and the indices of refraction for various gamma ray energies through gold. Further calculations were conducted to determine the fraction of the intensity of the incoming gamma ray beam that remains unabsorbed in passing through the lenses. These calculations were done using mass attenuation coefficients gathered by the NIST. Though more configurations need to be tested, a plausible system of three gold lenses with a central thickness of 150 μm and a radius of 500 μm focused a beam 300 μm in diameter of 1 MeV gamma rays into a single point on the optical axis at a distance of 2.65006 m from the center of the first lens. These three lenses would allow a significant fraction of the intensity (0.901400) to pass through to impinge on a detector. Further testing is needed to determine whether less costly material could be used to make gamma ray lenses, but with the research done so far, a practical gamma ray lens system is plausible.
KLF7 has been found to be an independent predictor of relapse in pediatric acute leukemia, and an increase in KLF7 expression is associated with poor response to chemotherapy. KLF7 is a member of a family of zinc finger transcription factors that are involved in numerous aspects of hematopoiesis, including the regulation of erythropoiesis, lymphopoiesis, and myelopoiesis. KLF7 is important for neurogenesis; however a role for KLF7 in hematopoiesis has not been previously described. The connection between increased KLF7 expression and leukemia, however, has led us to hypothesize that KLF7 regulates normal or leukemic stem cell functions. We now show that KLF7 overexpression inhibits hematopoietic stem and progenitor cell (HSPC) repopulating and colony forming ability. Also noticed in previous experiments was a severe decrease in the mature myeloid population from KLF7-overexpressing HSPCs, while T cell numbers were preserved. This leads us to predict that KLF7 expression is an important regulator of T cell development. Previous experiments have utilized a constitutively over-expressing lentivirus, and we will continue to further define this T cell phenotype in vivo (through transplantation assays) and in vitro. To further understand the role of KLF7 in T cell development, inducible lentivirus vectors will be synthesized to overexpress KLF7 in lineage committed hematopoietic stem and progenitor populations. In vitro and in vivo T cell production will be analyzed in these transduced cells to better understand this regulation. Transduced cells express GFP which allows the quantification of transduced cells vs. non-transduced cells by flow cytometry. Future studies will also assess the requirement for KLF7 in T cell development by utilizing Klf7 -/- chimeric mice.
Holocytochrome c synthase (HCCS) belongs to a family of proteins responsible for the assembly of cytochrome c by the attachment of the heme to apocytochrome c. Cytochromes c are heme proteins crucial to the conversion of energy in the mitochondria, imperative to the survival of all aerobic organisms. While HCCS is vital for the synthesis of holocytochrome c through the attachment of heme to apocytochrome c, little is known regarding the mechanisms behind this process. Recently, or the first time, the Kranz lab has purified and characterized HCCS. It naturally binds the heme and also the apocytochrome c. These achievements have made it possible to understand which residues in the HCCS protein are required for substrate binding and/or attachment. A deeper understanding of how HCCS functions can be achieved by making mutations to potentially important residues in HCCS. There are approximately 32 completely conserved residues in all HCCS enzymes. Two residues have already been mutated and tested for function in the Kranz lab, one of which is needed for heme binding (His154). Here, an additional 27 residues are altered for investigation. The results include 15 correct clones of these HCCS mutants that will be tested for function as well as heme and apocytochrome c binding. The HCCS enzyme is involved with programmed cell death as well as mitochondrial dysfunctions, which can lead to a variety of diseases. Therefore, it is imperative to acquire an understanding of how this enzyme functions as well as what residues are vital to the successful synthesis of holocytochrome c.
Toward a Better Understanding of...

Fluctuation Analysis of the Gain Across a Microchannel Plate

David Goldfinger

Mentor: James Buckley

This work focuses on finding the gain of a microchannel plate. A statistical method is explained that relates gain to measurable quantities. This method is then employed on a particular microchannel plate, before and after it is coated with cesium ions to determine what impact that has on the plate gain. The potential for observing single electron peaks in a low intensity beam incident on the plate is also considered.
Perceptions of appropriate gender behaviors play an important role in parenting and subsequently in children’s development. This work examines the influence that parental gender perception might have on caring for preschool aged girls with Disruptive Behavior Disorders (DBDs). The disorders included in the investigation were Attention Deficit Hyperactivity Disorder, Oppositional Defiant Disorder and Conduct Disorder. These three disorders are characterized by disruptive behavior, such as aggression, impulsivity and disobedience, above and beyond normative levels. There is a dearth of literature on young girls with DBDs because the disorders are more common in boys.

In general, it has been shown that parents are less accepting of perceived atypical gender behavior in young children of both genders. One key area where this appears is the disruptive behavior domain. Preschool girls are expected to display less disruptive behavior than preschool boys. Consequently, when young girls demonstrate these behaviors, adults view it as more concerning and atypical. Conversely, when these behaviors are demonstrated by boys, parents may tend to normalize it. It has been found that some adults respond more negatively toward disruptive girls and react to their behavior with anger and frustration. Additionally, studies have shown that negative reactions by parents and non-parental adults can lead to reciprocal effects that further increase the initial disruptive behavior. Based on the literature, parents and non-parental adults who care for girls with DBDs may benefit from an enhanced awareness of their own gender biases in order to provide adequate support and avoid increasing disruptive behavior. Additionally, DBDs in preschool girls is an area in need of more attention and investigation from researchers and clinicians to determine clinical thresholds.
Toward a Better Understanding of Dynamic Shear Testing and Indentation of Soft Anisotropic Tissue

Olivia Gonzalez

Mentors: Philip Bayly and Ruth Okamoto

Studying how the brain deforms in response to force can provide insight into brain development and traumatic brain injury (TBI). Indentation and dynamic shear testing (DST) are experimental methods that can be used to measure the mechanical properties of brain tissue. The brain is composed of gray matter; believed to be isotropic (i.e., stiffness does not depend on loading direction) and white matter; believed to be anisotropic (i.e., its stiffness depends on the direction of loading). The objective was to use readily-available soft materials to establish DST and indentation methods for isotropic and anisotropic tissues.

A gelatin-glycerol mixture was used to model isotropic materials. Chicken breast (skeletal muscle) was chosen to model soft anisotropic materials. The effects of sample diameter, thickness, orientation, and storage were investigated, as well as the effects of friction during indentation. The chicken breast was stored in air, artificial cerebrospinal fluid (aCSF), or water. Friction during indentation was varied by the addition of oil between the sample and the indenter. To investigate the effects of sample orientation, samples were loaded at 0°, 45°, and 90° with respect to a reference axis. In chicken muscle the reference axis was the fiber direction; in gelatin the reference axis was arbitrary.

Larger samples (15 mm diameter; 3 mm thickness) provided the best signal-to-noise ratio and reproducibility. In gelatin, there were no significant differences in stiffness due to orientation. However, in chicken breast, significant differences (p < .05) in elastic moduli were found from 45° and 0° DST data. Significant differences were found between properties of tissues stored air and water, and between air and aCSF, but not between water and aCSF. These results show that sample storage and geometry are important to control when testing brain tissues, and that varying orientation can be used to characterize anisotropy.
Potential Role of MicroRNA-758 in the Pathogenesis of Alzheimer’s Disease

Rohan Gopinath

Mentor: Jungsu Kim

Alzheimer’s disease (AD) is a neurodegenerative disease that is the most common cause of dementia in the elderly. Abnormal accumulation of amyloid beta (Aβ) peptide in the brain has been hypothesized to trigger pathogenic cascades that eventually lead to AD. Aβ peptide is generated by the sequential proteolytic cleavage of amyloid precursor protein (APP) by β- and γ-secretase. The proteolytic activity of β-secretase, also known as β-site APP cleaving enzyme1 (BACE1), is altered by cholesterol dysregulation. ATP-binding cassette transporter A1 (ABCA1) plays a critical role in maintaining cholesterol homeostasis. Thus, regulation of ABCA1 levels has been identified as a potential therapeutic target for AD. Recently, microRNAs (miRNAs) have been identified as important regulators of disease-related genes in diverse settings such as AD. In particular, miR-758 has been identified as a miRNA that post-transcriptionally controls ABCA1 levels. First, we identified miR-758 as a regulator of ABCA1 with multiple predicted binding sites on the 3’UTR region of its mRNA transcript. Next, we found that miR-758 represses endogenous ABCA1 levels in both HT22 and H4 WT cells. The suppression of ABCA1 by miR-758 leads to subsequent increase in production of Aβ peptide. Furthermore, miR-758 was identified as a novel regulator of cAMP response element binding protein (CREB), a transcription factor integral in forming spatial memory. In both HT22 and H4 WT cells, miR-758 was found to repress endogenous CREB levels. In conclusion, we suggest that miR-758 represses ABCA1 expression which leads to subsequent increase in Aβ peptide levels. In addition, miR-758 was shown to decrease CREB levels which could lead to the loss of spatial memory associated with AD. Thus, miR-758 may play a critical role in AD pathogenesis and warrants further studies.
Toward a Better Understanding of...

Examining the Effects of Response Mode on Free Recall

Christian Gordon

Mentor: Henry Roediger

We studied how the effects of varied response modes (such as typing or writing) affected future recall. Specifically, we examined whether the testing effect was merely a result of restudy during retrieval. Our hypothesis was that there would be no significant difference between typing visible (subjects could see the words as they recalled them) and typing invisible (they could not see the words as they recalled them). The types of response modes were: typing visible, typing invisible, handwritten, restudy, and no restudy. Each subject studied 10 words each from categorized lists (clothing, sports, birds, professions, and fruits), and then responded in one of the 5 response modes for each category across two tests. Following a 15-minute distractor task, subjects received both free and cued final free recall tests to measure memory for the word lists. There was no statistical difference between the typed visible and typed invisible conditions. Although there was not a strong testing effect, our results supported the hypothesis that response mode did not affect free recall testing, suggesting that the testing effect was a result of retrieval and not restudy.
Emergent literacy refers to the idea that learning about language and print is a gradual process that begins before children receive formal literacy instruction. Emergent literacy plays an important role in learning to read and developing lifelong reading skills. The current study examines one aspect of emergent literacy, the home literacy environment, to investigate how young children begin to learn about letters, sounds, and print. Most studies on the home literacy environment have focused on shared book reading; however, our goal is to explore whether other contexts promote literacy-related talk. The current study longitudinally investigates parent-child conversations about literacy during the preschool years. We analyzed one hour of conversations between 53 parent-child pairs that were recorded during everyday specific letter talk. General literacy talk refers to mentioning the topics of reading and writing without specifically labeling letters or words. Explicit letter talk refers to labeling specific letters, words, and sounds. Results indicate that children at 30 months old exhibit more general literacy talk than explicit letter talk. Children at 42 months old, however, exhibit more specific letter talk. At both 30 and 42 months of age, toy play promotes the greatest amount of explicit letter talk. However, at 42 months, children have begun to use more letter talk in activities related to writing and drawing. Results also indicate that children contribute to conversations at both 30 and 42 months of age only slightly less than their parents. Future studies will measure how children’s early exposure to print and literacy influences kindergarten readiness and reading preparedness.
Toward a Better Understanding of…

Isolation and Phenotypic Characterization of Virulent UPEC LPS Mutagens

Jordan Grainger

Mentor: Matt Conover

Uropathogenic *Escherichia coli* (UPEC) predominates as the most common urinary pathogen, causing approximately 85% of urinary tract infections (UTIs). Its virulence is due mostly to its ability to form Intracellular Bacterial Communities within a host, rendering the body’s immune response ineffective, and can often lead to recurrent infections. This study involves the genetic analysis of two lipopolysaccharide (LPS) mutagens of UTI89 in an attempt to better understand the mechanisms involved in bacterial proliferation. Two LPS mutants, ΔWaaL and ΔWaaW, were obtained on kanamycin plates following electroporation of UTI89 PKM 208 competent cells with PCR products containing kanamycin-resistance cassettes for the regions of the WaaL and WaaW genes. Colonies for ΔWaaL and ΔWaaW had diameters of 4-5cm and 1-2cm, respectively. Biofilm assays performed on both mutants revealed similar biofilm formations to wild-type (UTI89) after 24 hours in LB, while significant biofilms were unable to form in YESCA media. This suggests that by affecting the LPS layer of UTI89, curli production may be suppressed. When colonies were streaked out onto Congo Red indicator plates, a color discrepancy between mutant and wild-type UTI89 was observed, further supporting a possible connection between LPS and curli formation. Immunoblots of ΔWaaL revealed that the WaaL gene in UTI89 encodes for an enzyme responsible for ligating the O-antigen to the lipid A-core of LPS due to the absence of banding on the developed immunoblot. Further testing is necessary to determine if a similar effect is exhibited in ΔWaaW. Curli Immunoblots with CsgA primary antibody, a major subunit of curli fibers, revealed that the mutants’ curli production remained unaffected when grown in LB. However, further testing is required to determine if curli remain present when strains are grown in YESCA media.
Genetic fate mapping uses allelic recombination to permanently mark precursor cells and their descendants, which can be followed and characterized over time. This requires two genome based elements; a site-specific Cre-recombinase, and a conditional reporter allele. The output of the reporter is only observed in cells in which Cre reaches the nucleus, and because recombination happens at the genomic level, all of their decedents. Different activity levels of Cre and control of nuclear entry can be useful for lineage tracing experiments. Our lab has taken advantage of the Notch signaling mechanism to create Cre alleles that are only active when the pathway is engaged. These include untagged versions of Cre as well as C-terminal 6-Myc epitope tag fusions (Cre6MT). In vivo data demonstrates qualitatively that Cre6MT recombines DNA at a much lower frequency than untagged Cre. We hypothesized that because the DNA binding domain of Cre is in the C-terminus, the 6MT fusion was directly responsible for reduced activity. This work has focused on quantitatively assessing the difference in activity level between the two versions of the enzyme using an in vitro assay. Primary mouse embryonic fibroblasts (MEFs) were derived from Rosa<sup>vR26R</sup> embryos and transfected with increasing concentrations of DNA containing either Cre or Cre6MT and Luciferase (Luc). Cre-induced recombination of the R26R allele allows transcription of β-galactosidase, which is a measure of the recombination potency of Cre/Cre6MT. These experiments reproducibly demonstrate that Cre is 4-6 times more effective at inducing recombination than Cre6MT. This result is not due to differences in transfection efficiency or protein expression as Luc activity has been designed to reflect the amount of Cre/Cre6MT expressed. Equal stability of Cre and Cre6MT was confirmed by western blot. Furthermore, using next generation reporters that are easier to recombine, we show increased labeling efficiency in vivo using the same Cre6MT alleles. Together, these data convincingly show that Cre6MT is a markedly weaker enzyme than untagged Cre. This has important implications for design of Cre alleles; weaker activity could be taken advantage of where lineage analysis requires marking only a few cells, while caution should be used in adding C-terminal fusions when maximum recombination is desired.
Toward a Better Understanding of...

Characterization of Novel Chromodomain Protein Involved in Programmed DNA Rearrangements in *Tetrahymena thermophila*

Rachel Greenstein

Mentor: Douglas Chalker

During sexual development of the ciliate *Tetrahymena thermophila*, the somatic macronuclear genome undergoes dramatic reorganization resulting in the elimination of around 30% of its germline derived DNA. The selection of the sequences to be removed is similar to mechanisms used by other eukaryotes to establish heterochromatin and provides a unique model to examine DNA regulation via chromatin modifications. The predicted gene *Ttherm_00565610* encodes a large chromodomain containing protein with a microarray expression profile similar to the chromodomain protein Pdd1 (*Programmed DNA Degradation protein 1*), which has been shown to be required for this genome rearrangement process. Pdd1 associates with heterochromatin-like structures localized into distinct nuclear foci where DNA elimination occurs. Fluorescence microscopy using a C-terminal endogenous tagged versions of *Ttherm_00565610* results in localization to these nuclear foci. Additionally, co-localization with endogenous CFP-tagged Pdd1 reveals significant overlap of their positions, with *Ttherm_00565610* appearing to surround the tighter Pdd1 foci at later time points. Together these results suggest involvement of this novel protein in the DNA rearrangement of *T. thermophila*. Preliminary analysis using *Tetrahymena* cells in which *Ttherm_00565610* has been disrupted reveal that this gene is not essential for vegetative growth, but is required for conjugating cells to complete their development. Efforts to further investigate the developmental phenotype of these gene knockout strains promise to reveal whether *Ttherm_00565610* is required for genome reorganization and elucidate its role.
Human epidermal growth factor 2 (Her2) dimerization with other growth factor receptors normally leads to cell division. However, Her2 gene over-expression is seen in approximately 20% of invasive types of breast cancer, and it is often resistant to conventional therapy. Herceptin, a prevalent treatment, is a monoclonal antibody that attaches to Her2 receptors and prevents them from signaling cells to divide. Imaging of Her2 expression is difficult for patients undergoing Herceptin therapy, though, because excess amount of this antibody blocks binding sites and does not allow for the true level of Her2 expression. Therefore, we study two antibodies, called 2H9 and 7D8, which target different epitopes of Her2. They are chelated with Desferrioxamine (DFO), purified with desalting columns, and labeled with Zr-89. Cell uptake of these antibodies is much higher in Her2 positive cancer cell lines, and 2H9 is consistently taken up more than 7D8. Cell competition binding assays examine the binding affinities of the antibodies conjugated with and without DFO, and we find that there is a 4.2 fold decrease in binding affinity between the modified and unmodified 2H9, versus a 1.2 fold decrease with 7D8. A saturation experiment determines the point at which cells take up 50% of the antibody, and the resulting saturation curves show that more antibodies must be added to the cells to further clarify the saturation points. A cell internalization experiment examines the rate at which Her2 positive cells internalize 2H9 and 7D8, and we find that half of the 2H9 quantity is internalized in six hours, versus fifteen hours for 7D8. Ultimately, the goal is to maximize the amount of radioactive agent and minimize the amount of antibody necessary to image Her2 positive cancer tumors in vivo.
Malnutrition is a large problem in developing countries, specifically in Sub-Saharan Africa. Malnutrition is often looked at as a point of possible intervention by various public health organizations and advocacy groups because malnutrition itself leads to a host of other problems including increased susceptibility to disease, infection, and stunted growth. Therefore if the problem of malnutrition can be solved, it is likely a variety of other problems will also begin to dissipate.

For this reason, Uganda Development and Health Associates (UDHA), a non-governmental organization located in Iganga, Uganda, has decided to begin fighting this issue through education. Through the use of a team of fifteen community health workers, UDHA implemented an intervention in the summer of 2010 aimed at reducing malnutrition in children under the age of five. These community health workers are tasked with performing quarterly growth monitoring checkups on the children of the community, holding monthly community sensitization meetings, supervising the establishment of backyard gardens and holding quarterly food demonstrations.

This single case study evaluation of this initiative attempted to analyze both the successes and deficiencies. Along with the staff of UDHA and another student, we performed numerous semi-structured individual interviews with mothers, fathers and community health workers, separate focus group discussions with mothers, fathers and community health workers, analyzed the community health worker’s registries and general observation. The information from each of these mediums was transcribed and analyzed.

The results from this study promise to be of high value to UDHA as they continue to improve this intervention and hopefully expand it to nearby communities. It is my hope that what I determined to be successes would be emphasized in future improvements to the intervention and that what I determine to be deficiencies will be improved upon.
Candidiasis often presents itself as a yeast infection of the small intestine of very low birth weight infants (VLBW). Translocation of the colonizing yeast across either healthy or damaged intestinal epithelial cells can have devastating effects on infants, specifically neonates, and can result in death. We have demonstrated in past experiments that *C. albicans*, the predominant yeast species recovered in VLBW infant infections, translocates at higher rates across neonatal enterocyte monolayers than adult enterocyte monolayers. We have also shown that secretion of IL-8 is also increased following exposure to this species. We hypothesize that the increase of IL-8 secretions plays a role in the translocation rate difference between neonatal and adult enterocytes. To test this hypothesis we examined the effects of anti-inflammatory pretreatments with both neonatal and adult enterocyte monolayers on candidal translocation and IL-8 expression. This data will help point our group in new directions concerning disseminated candidiasis as we search for the underlying mechanism causing the dissemination.
The separation of children from their mothers has received significant attention in research on Sub-Saharan Africa; whereas this literature predominately focuses on the perspective of the children, I have attempted to expand the characterization of mother-child separation by focusing on the experience of mothers. Using Lesotho as a case study, I have conducted a descriptive analysis revealing characteristics associated with mothers living in the household with all or some of their children compared to mothers living with none of their children. Using 2009 Demographic and Health Survey data, I conclude approximately 75% of women (15-49) live with all of their children (0-17), 15% live with some of their children, and 10% live with none of their children. Additionally, mothers living with none of their children are more likely to live in urban areas, have higher levels of education, and those working are more likely to participate in domestic work and skilled and unskilled manual labor. Moving forward, these findings may serve as a preliminary step into further research on mother-child separation, exploring the reasons why these specific characteristic are associated with mothers who live with none of their children.
Accumulation and aggregation of amyloid-beta (Aβ) peptide in the extracellular space of the brain is a major pathological hallmark of Alzheimer’s disease (AD) and is known to occur years before clinical symptoms develop. Sleep quality degrades with aging but is more severely impaired in AD. Previous research indicates that decreased signaling of orexin, a hormone which regulates wakefulness, in a mouse model of AD results in decreased accumulation of Aβ plaques in the brain. It is unknown whether the changes in orexin or secondary changes in sleep by orexin causes the decreased Aβ plaques in the brains of mice. We hypothesized that focal overexpression of orexin will lead to increased wakefulness as well as increased Aβ plaques in the brain. Mutations in the genes of amyloid precursor protein (APP) and presenelin 1 (PS1) are known to increase AD pathology in the brain by increasing aggregation and accumulation of Aβ. A lentiviral vector containing orexin cDNA or a control vector was injected in the bilateral hippocampi of APP/PS1 mice. Sleep-wake cycle was monitored by electroencephalography (EEG) and electromyography (EMG) along with measurements of interstitial fluid lactate, a measure of brain activity, using microdialysis. Both results are compared. Overexpression of orexin did not increase gross wakefulness in comparison to the control mice. Lactate levels fluctuate according to the sleep-wake cycle, but did not show differences between the two groups. There was no difference in the amount of Aβ pathology between groups. Current results suggest that focal overexpression of orexin in the hippocampus does not affect the sleep-wake cycle as well as Aβ pathology in the brain. Overexpression of orexin in different brain areas which govern the sleep-wake cycle or knocking out of orexin in the mouse models of AD may further demonstrate the relationship between the sleep/orexin and AD pathology.
This project examines how competing forms of public transportation in Bogotá, Colombia serve as a platform for understanding shifting notions of urban planning in Latin America as well as how processes of globalization have influenced government decisions to implement new and formalized systems of transportation in developing countries. Public transportation in Bogotá has traditionally been structured as an informal system of small municipal buses called *busetas* or *colectivos* that are still widely used today, especially among low-income workers who dwell in many of the city’s informal peripheral settlements. In 2000, under the leadership of Mayor Enrique Peñalosa and his vision to “recover public space”, the city began a process of formalizing its system of public transportation and established a modern public bus system called *TransMilenio*, a bus rapid transit system (BRT) that was hailed as a safe, environmentally friendly and efficient mode of public transportation that would improve urban mobility and lower the cost of public transit. Using ethnographic methods, the project tracks the formalization and modernization of Bogotá’s public transportation to offer insights on the changing nature of urban planning in Bogotá and the extent to which public transit acts as a segregating or unifying mechanism within a fragmented and socioeconomically divided city.
Pollination is considered a critical ecosystem service that is necessary for the reproductive success of 90% of flowering plant species. Despite this, little is known about how pollinator communities colonize and how plant-pollinator interactions function in newly restored ecosystems. This research investigates how the size of the restored habitats influences the diversity of pollinators, and the effectiveness of pollination to a focal plant species. We focused on Coreopsis lanceolata in experimentally restored Ozark glade habitats at Tyson Research Center. Coreopsis lanceolata is a generalist-pollinated plant that occurs in glades of all sizes. In glades of three different sizes, we recorded the density of C. lanceolata flowers, performed pollinator observations, collected and identified visitors, and collected inflorescences to determine seed set. This study found that big glades have a higher visitation rate than medium glades, and mediums have a higher visitation rate than smalls, and bigs have higher bee species diversity than medium or small glades. Big glades would have the advantage of a larger continuous habitat where a greater number of bee species could likely find niches. However, glade size did not affect seed set. This indicates that reproduction of Coreopsis lanceolata is not pollen limited. This study suggests that larger habitats are needed to restore diverse bee communities, but generalized plants such as Coreopsis lanceolata are able to achieve adequate pollination and reproductive success even in small restorations. Future studies are necessary focusing on generalized and specialized pollinated plant species to determine the generality of our results.
Georg Simmel begins “The Metropolis and Mental Life” by asserting that “The deepest problems of modern life flow from the attempt of the individual to maintain the independence and individuality of his existence against the sovereign powers of society.” To Simmel, modernity’s metropolis is characterized by this conflict between the individual and society; without the consuming social mechanism, there would be no modern city, but without independent elements within the crowd, there would be no growth or innovation. Both Iris Murdoch and Virginia Woolf explore this relationship between the individual and the crowd in their London novels, and the conflict is especially relevant in their treatment of the Thames. Woolf sees the London crowd and traffic as a current, a reflection of the Thames made up of individual lives. She connects the Thames and the crowd most clearly in her essays “Thunder at Wembley” and “Street Haunting: A London Adventure” and in her novel *Orlando*. Iris Murdoch is more fascinated with the social pressures that the city puts on individuals, and she expresses her characters’ struggles with society through their interactions with water. Many characters in her *oeuvre* experience a violent ordeal by drowning, and these moments, most involving naked characters, serve to distill the individual from the crowd. This project discusses the ways in which these two authors use water to portray the experience of the individual in the metropolis. Research for it involved extensive study of the authors’ novels, secondary sources, and urban theory, as well as time spent in London following the paths of characters and studying the importance of the Thames in exhibitions at the National Maritime Museum and the British Library.
Volumetric and Cortical Thickness Analysis of the Insular Cortex in Children with a History of Preschool Onset Depression

Jaclyn Hopp

Mentor: Kelly N. Botteron

The insula, a region of the brain located in the cerebral cortex and component of the limbic system, participates in emotion and mood regulation. Major depressive disorder (MDD) is a debilitating and common psychiatric disorder, which can affect emotions, thoughts, sense of self, behaviors, physical functioning, and biological processes. Children as young as three years old can express clinically significant symptoms of depression; therefore, it is necessary to identify anatomical differences in the brain to better understand the underlying neurobiology of childhood depression. Research with depressed adults showed volume reduction in the left anterior insula compared to healthy controls. We hypothesize a decrease in left insula volumes in depressed subjects compared to healthy controls. Past studies show cortical thinning in depressed adult subjects. We hypothesize depressed subjects will show insular cortical thinning compared to the control group. For this study, we used a subset of 30 subjects from a larger longitudinal study of children with preschool onset depression. The average age of subjects was 10 years; we also matched for sex, IQ, and income. Two groups, healthy controls and affected, containing 15 subjects were analyzed. We acquired MRI images, which show the structural anatomy of the brain. Using a computer program, we manually traced the left and right insula. We measured both volume size and cortical thickness of the insula.

We expect to see results consistent with our hypotheses; however, we are unsure if the proposed changes will be identified during early childhood. Due to the shortage of literature on childhood depression, it is necessary to identify neurobiological of depression markers in children. Future research should include volumetric and cortical thickness analysis on anterior and posterior regions of the insular cortex.
GABA is one of the main inhibitory neurotransmitters in mammalian brains. The receptor complexes of two types of major GABA_A receptors, synaptic and extra-synaptic, are thought to be pentamers. While the synaptic GABA_A receptors have been shown to consist of two α subunits, two β subunits, and one γ subunit, the stoichiometry of extra-synaptic GABA_A receptors remains controversial. The goal of this study was to determine the subunit stoichiometry and combination of extra-synaptic GABA_A receptors.

After injecting different cRNA subunit combinations into *Xenopus Laevis* oocytes, we used the two-electrode voltage clamp technique to analyze the responses of egg cells with different subunit combinations to different perfused drugs. We compared the channel activity of cells with free subunit (and thus freely binding) cRNA, a δβα+βα subunit combination, and a δβα+βδ subunit combination. We introduced the cells to different concentrations of pentobarbital in the presence of a response saturating concentration of GABA and different concentrations of taurine. When perfused with pentobarbital and GABA, the cells with free subunits (EC_{50} = 30 μM) responded similarly to the δβα+βα cells (EC_{50} = 41 μM) over the δβα+βδ cells (277 μM). In contrast, when perfused with taurine, the cells with free subunits (EC_{50} = 0.2 mM) responded similarly to the δβα+βδ cells (EC_{50} = 0.9 mM) over the δβα+βα cells (EC_{50} = 6.1 mM). These data suggest that either the receptors themselves act differently in the presence of different drugs or that the pentamers bind in a combination different from the two we studied.
British colonization of North America occurred in a variety of different climates and political environments. The experiences of colonists settling in the West Indies were in many respects as different from the experiences of those settling in New England as they were from life in England. Even the reason for coming to the New World at first seems to divide the colonies: some come for religious freedom while others seek quick profits and a life of ease. Within this framework, parallels between the colonies seem at first cloudy and weak. Upon further analysis, however, overarching economic similarities between the colonies begin to emerge. Gradually, what at first appear to be differences between the colonies yield generalizable truths for a successful colony. Colonial economies can be seen to develop products in high demand internationally, causing exports that in turn yield internal colonial economic development. The promise of wealth drove increased immigration to the colonies, which in turn strengthened cash-product development and internal colonial demand for foodstuffs and other basic necessities, effectively creating regional markets whose intended consumers resided on the North American side of the Atlantic. Therefore, from a diverse range of colonial experiences, including West Indian Sugar Planters and New England Cod fishermen, British North American colonial development can be viewed as a search for successful cash-products and subsequent economic growth on the back of those products. Specifically, the development of production with regards to tobacco, sugar, and cod can be seen as the driving factors behind the success of colonies in the Tidewater Region, the West Indies, and New England. The goal of this project is to research the development of these industries and successfully draw parallels between them, in an effort to prove that cash-products drove the development of colonies above all other things.
This project analyzed the recent evolution of the debate on gay and lesbian rights in Uganda. The media is a compelling point of academic examination, for it acts as a conduit for voicing anxieties that surround social and political issues. It is important to note that what is said is equally valuable to the discussion as what is omitted or silenced. In deconstructing the claims forwarded by dissidents of gay and lesbian rights, this project exposes and analyzes the ideological underpinnings that affect the way that debates about homosexuality are dealt with and worked out in contemporary Uganda. The primarily state-owned, Ugandan newspaper, *New Vision*, is the primary source of articles and editorials for this project. Particular attention is paid to articles published between 2004 and 2012 that focused on gay rights, anti-gay rhetoric, opinions of secular and religious leaders, and significant historical events that establish the etiology of the debate. Analysis of newspaper articles reveal that the vocal majority of Ugandans draw upon on conservative and traditional interpretations of “African-ness,” the structure of the family, the role of reproduction, and the Bible in making their claims that homosexuality in Africa is a Western import and is thus un-African.
Cryptic species is defined by groups of organisms sharing similar morphological traits but reproductively isolated from each other. They are commonly regarded as the early stage following a speciation event, during which recognizable phenotypic differences have not yet developed between different groups. Accordingly, they are important systems to study the process of speciation. Characterized by a unique mating system with various flower/fruit types, *Amphicarpaea bracteata*, also known as American hogpeanut, is an annual legume widely distributed in eastern North America. With limited sample and geographic coverage, a previous study had suggested three distinct genetic groups within the *A. bracteata* species. In this study, the genetic diversity of *A. bracteata* was surveyed using a larger and geographically more thorough sample (~400 individuals). Six new microsatellite markers were developed. Polymorphisms of these microsatellite markers were assessed in conjunction with the DNA sequence polymorphisms in the internal transcribed spacer (ITS) region to determine the amount of genetic variation between and within populations. The results revealed two major lineages of *A. bracteata*, with very little interbreeding between the two lineages; no third distinct genetic group has been identified yet. Very few heterozygotes were detected, indicating high inbreeding within each group. Geographically, the two lineages could potentially distribute along a longitudinal gradient from east to west, which is rarely seen in other North American native species. The results also indicated that *A. bracteata* is at an early stage of cryptic species formation.
Mineralogical and geochemical studies of terrigenous sediments have been instrumental in deciphering aspects of Antarctica’s glacial history. The characterization of sediment source areas around the Antarctic continent using the $^{40}$Ar/$^{39}$Ar ages of individual hornblende and biotite sand grains and the Nd composition of the terrigenous fine ($<63 \, \mu m$) fraction has set the stage for ice sheet behavior to be reconstructed through sediment provenance (i.e., place of origin) studies. These studies have demonstrated that the varied geologic history around Antarctica allows using this approach to identify contributions from different ice sheet sectors. However, the establishment of additional provenance proxies is needed to reconstruct past ice sheet behavior with greater certainty, particularly during intervals where there is a contrast in apparent provenance from the sand grains and fine fractions. Here, we characterize the terrigenous fine fraction of different sources near Wilkes Land, Antarctica, by estimating K-Ar ages from argon concentration measurements. We show that the estimated K-Ar ages of fine-grained sediments from IODP Site U1356 indicate changing provenance during ice-rafter detritus (IRD) abundance maxima at ~13.8 and ~13.0 Ma. We found that the K-Ar ages from IODP Site U1356 sediments, deposited within and shortly after the Middle Miocene Climate Transition (~14.2–13.8 Ma), concur with previously obtained $\varepsilon$Nd values and indicate significant contributions from relatively young sources. This indication of changing fine-sediment provenance contrasts with the unchanging dominant IRD provenance inferred from hornblende $^{40}$Ar/$^{39}$Ar ages and may reflect rapid erosion of the Ferrar Group ($^{40}$Ar/$^{39}$Ar and K-Ar age of ~180 Ma) during glacial outburst floods. Results demonstrate that the K/Ar system can be a valuable proxy for the provenance of fine-grained sediments in the Southern Ocean and a useful tool in studies of Antarctica’s glacial history.
Research on diasporic subjectivity by Lily Cho and Paul Brodwin, among other theorists, suggests that diasporas are locally produced, subjective conditions, not simply groups of people. Rather, we should think about diasporic communities as states of existence, collective experiences and conditions of life that are shaped by internal and external power relations in both the homeland and the receiving community. This ethnographic research uses the idea of diasporic subjectivities to explore the disparate experiences of Haitians who immigrated to St. Louis during the Duvalier dictatorship in the 1960s and Haitians who immigrated to St. Louis after the coup d’état of President Jean Bertrand Aristide in 1991. Through in-depth interviews this generational study examines the changing local social dynamics within the Haitian diasporic community in St. Louis as a lens to understanding how ideas about Haitianess are reproduced in the diaspora. The research is particularly focused on how patterns of Haitian cultural tropes such as the choice of language use, and the presumed rigidity of class identification have influenced individual and group behavior in this particular community. Despite the apparent cultural similarities between Haitians in St. Louis, by analyzing competing discourses of shared Haitianess and discourses on lines of difference, the research refutes the common scholarly perception of a singular Haitian diasporic community. I suggest that differences in Haitian consciousness have contributed to a multi-layered Haitian community in St. Louis. This research thus adds to the knowledge of Haitian diasporic subjectivities and the flexibility of cultural tropes, and to the understanding of why people may not exhibit solidarity in diasporic communities.
During the second century CE, a broad variety of groups considered themselves to be “Christians” in the sense that each group claimed to be the true followers of Christ’s teachings. Yet these groups had different understandings of creation, accepted different Scriptures, and advocated different lifestyles. One extant work from this time period is Irenaeus’ *Against Heresies*. This text is Irenaeus’ five-book response to a request from other proto-orthodox “Christians” asking for a description and refutation of the Valentinians, another group of second century “Christians” whose belief system Irenaeus viewed as incompatible with his own. Though the request was for a refutation of the Valentinians, in the text, Irenaeus refutes a number of other “Christian” groups and promotes his own form of “Christianity”—a version of Christianity that was largely confirmed by the First Council of Nicea. *Against Heresies* is pivotal in that it is an early example of proto-orthodox thinking. Irenaeus’ emphasis on Scripture and tradition as well as the clear distinction the church draws between orthodoxy and heresy still exist in Christianity. Furthermore, *Against Heresies* provides insight into the relationship between various second century “Christian” groups vying for supremacy. This research elucidates this relationship by exploring the change in Irenaeus’ strategy over the course of the five books of *Against Heresies*. While Irenaeus clearly views these five books of *Against Heresies* as interconnected, it is important to note that the books were not all written and sent at once. I argue that there is a shift in Irenaeus’ strategy over the course of the text. In Books I-III, Irenaeus is primarily interested in preventing current proto-orthodox “Christians” from converting to other forms of “Christianity.” In Books IV and V, however, Irenaeus focuses on converting those “Christians” he opposes to proto-orthodox “Christianity.”
The Endangered Species Act of 1973 (ESA), referred to as the “crown jewel” of American environmental law, passed through Congress with nearly unanimous support. Within years, however, members of Congress were proposing to amend the Act and even eliminate it entirely, making the ESA one of the most controversial pieces of legislation of the 20th century. Past research, while informative, largely avoids discussion of the intricate relationships between voters, lobbyists, and politicians that were critical in the formation of the ESA. This project investigates the change in support for the ESA and the factors that contributed to its controversy. More generally, the work translates a typical historical narrative of the ESA into a formal institutional model that was first introduced by Olson (1995) and Sened (1997). This model, the Voter Proximity Model, suggests that policymakers vote on legislation with an intention of maximizing total expected votes for their re-election. A core implication is that lobbyists can influence a policymaker’s vote on a bill only if they have direct leverage over votes in that official’s re-election. These findings can help further question the motivations of politicians in negotiating public policy. The work is a basic, yet enlightening, step in understanding the Congressional process.
Malaria is a serious global health issue that is endemic to most of the developing world, affecting nearly 500 million people and causing 1 million child deaths each year. It is a disease caused by the apicomplexan parasite, *Plasmodium falciparum*, and transmitted through the mosquito vector, *Anopheles gambiae*. The malaria parasite exhibits many cellular responses that are most likely coordinated via extracellular chemical communication, but the mechanisms and specific agents that allow this communication are almost entirely unknown. Since these extracellular signals may be highly volatile compounds, we evaluated for these chemicals in the headspace gas above the media of cultured *P. falciparum* malaria parasites.

Using solid phase micro-extraction (SPME) and an airtight tubing system connected to a peristaltic pump, the headspace gas of a malaria culture was passed over the SPME fiber to collect the volatile organic molecules into the fiber. Two monoterpenes isoprenoids were found to be present in malaria headspace gas alone. Monoterpenes are odorants with signaling roles in bacteria, plants and fungi. These roles include quorum sensing; as well as inter-species communication, such as the attraction of arthropods. To test the possibility of inter-species communication, we tested these specific monoterpenes for the ability to activate 80 *Anopheles gambiae* odorant receptors. Two of these compounds significantly increased receptor activity. To evaluate for quorum sensing effects of these compounds, we treated *P. falciparum* cultures with these isoprenoids, and looked at their growth rates. Ongoing studies are in process to evaluate whether these compounds affect the growth rate of single parasites, and are performing high-throughput functional analysis of previously uncharacterized *Plasmodium* genes to identify the *Plasmodium falciparum* terpene synthase. Identification of the genes responsible for our findings will substantiate our discovery of an entirely novel biosynthetic pathway in *Plasmodium falciparum*. 
Malaria is a disease that remains a serious problem for millions in underdeveloped regions, and present day efforts are focused on treatment and eradication of malaria worldwide. *Plasmodium falciparum* is the specific malaria species of our research because of its significance in causing the most deaths in infected individuals. One direction of research focuses on proteases that the malaria parasite uses for a wide range of essential roles, including host cell invasion, egress, and degradation of hemoglobin. There are many uncharacterized metalloproteases expressed during the parasite’s life cycle, and determining the specific function of two of these proteins was the focus of our study. We hypothesized that based on gene sequence homology, these metalloproteases have functional relevance during the parasite’s development in the host red blood cell (RBC), so two different approaches were used for each of the proteins of interest. One method attempted was gene knockout to study the loss of function in the null mutant strain versus wild type via double crossover recombination followed by drug selection. Parasites have been transfected with the knockout vectors and we are awaiting results to see possible phenotypic change. Such will indicate that the peptidases play an active role in the parasite’s growth in the RBC. The second method was to examine protease function through bacterial expression of these proteins. The coding sequences for the two proteins of interest were cloned into expression vectors then transformed into and expressed in *E. coli*. The proteins of interest have been purified via affinity tags that were fused to our proteins. Future biochemical assays will highlight the peptidases’ role in parasite development. It is expected these studies will give further insight into *P. falciparum* biology and may aid in drug design to combat the disease.
With the ever-growing obesity rates worldwide, better quantitative methods of body composition analysis are needed to analyze the effectiveness of interventions. Due to fat’s characteristic low x-ray absorption, Computer Tomography (CT) allows quantitative assessment of fatty tissue and cross-sectional anatomic differentiation. In this study we examined the feasibility, reliability, and reproducibility of a new state of the art methodology to analyze body fat composition with low dose CT in pre-clinical non-human primates enrolled in a therapeutic intervention program on human sized clinical systems. A regional assessment was conducted on four single CT images at the pubic bone, sacral pelvic junction, pelvic crest, and lower pole of the lowest kidney. A total of 516 data sets were analyzed using threshold-segmented region of interests (ROI). Several experimental scanning parameters were used to test feasibility of different conditions. The use of segmented ROIs showed lower reproducibility error compared to the traditional method of longest diameter measurements of fat deposits. Comparison between different energy levels revealed an overall slight overestimation of the volume of fatty tissue on the lower energy approach but showed promise for comparison between different time points. A comparison between pre-contrast images and post-contrast images revealed that the volume of the fatty tissue was always calculated to be larger in the pre-contrast scan. Both of these test conditions show promise for anatomical differentiation. Biological examination and imaging with other modalities such as MRI could provide additional insight into the accuracy of these measurements. We demonstrated the benefits and limitations of different methodological approaches as well as feasibility for regional cross-sectional body fat assessment.
As universities strive to serve their students to the best of their ability, they must take into account a growing population in their student body: the deaf and hard of hearing (DHH). Since the passing of the Americans with Disabilities Act of 1990, institutions are barred from discriminating based on ability. The first generation of children to grow up entirely under the ADA is now at the age and in the position to pursue an education past high school. Additionally, the advent of cochlear implants aid the deaf in functioning independently in the general population. As a result, deafness interferes less and less with daily duties. However at the college level the DHH are still at a disadvantage with their writing. Many struggle to grasp grammatical structures, similar to hearing second language learners, and have difficulties organizing ideas in a linear progression.

I argue universities need to invest more in writing support for these students, beyond simply assuring DHH students can sit in a lecture class or communicate with a tutor, and must address the barriers that prevent these students from fully expressing themselves on paper. I attend to the interconnectedness of lower order concerns—problems on the sentence level—and higher order concerns—problems on the macro level—in the writing of the DHH. In order to treat each student as an individual, hearing and DHH alike, I propose writing centers mainstream DHH students into the regular program by employing techniques, such as visual maps and other organizational tools, which aid these students as well as the general body of students.
Cancer immunotherapy is a growing area of research interest. Currently, immune system cells are removed from a patient’s body and T cells are infected with a viral vector bearing a T cell receptor (TCR). Those T cells are then multiplied before being restored to the immune-depleted patient. Due to the culture step of this method, it is expensive. A new method could involve generating and injecting a retroviral construct which encodes the TCR of interest directly into a patient’s lymph nodes. From there, the virus will infect T cells, causing them to produce the desired TCR. Upon activation, the T cells will amplify according to a normal immune response. This method would enable a generalized virus to work with a variety of patients and will be less expensive. Work on analyzing the virus and virus infectivity in vitro shows that the virus successfully causes T cells to produce the TCR of interest. Further work in the RIP-OVA mouse system will show if the virus is capable of infecting in vivo.
Music therapy is a discipline in which credentialed professionals use music within a therapeutic relationship to address physical, emotional, cognitive and social needs of individuals. In the U.S., music therapy is gaining legitimacy as a medical treatment as its methods become standardized and its benefits and mechanisms of healing become more understood. However, the uniqueness of musical healing practices lie in the philosophies, musical background and cultural heritage of the practitioner. In India, music has historically been, and continues to be, an essential component of the practices of traditional healers. The present study aims to profile Indian musical healing practices and to discuss the potential integration of traditional Indian healing systems with music therapy. Methods of analysis include interviews of various practitioners and observations of music healing sessions in several cities in India. Several distinct forms of Indian music healing are identified and comments are made regarding further areas of research and the next steps for the profession in India.
This project aims for a better understanding of politicians’ re-election strategies and how they appeal to constituents in their discourse. Such an understanding would allow for better informed citizens on the workings of our democracy.

The work examines the content of speeches given by United States Senators from 1994 until the present. More specifically, I use a script coded in the Ruby programming language to generate frequencies of the number of times a Senator utters his or her home state in every year during the previously mentioned time span and hope to find evidence that the number of state mentions increases during the fifth and sixth year of a Senator’s six-year term.

This finding would support previous literature on the representational implications of symbolic speeches in the U.S. Senate, in which the amount of constituency identification and constituency empathy speeches were greater than general policy speeches during election years. Politicians may reference their home states in praise of successful state level policies, to congratulate local sports teams, to advocate for legislation favorable to their constituents, or to generate media sound bites favorable to their re-election strategies. If the hypothesis proves to be true, I will analyze the content of speeches that do reference the home state and compare it to the content of the speeches that do not to find out which issues or ideas are being associated with a Senator’s home state. These would be the issues or ideas that the Senator believes are important to his or her home state's constituents.
Researchers have long searched for solutions to age-related memory deficits. One possible target for intervention is event segmentation, an automatic process in which humans break up the flow of everyday activity that is critical in subsequently remembering those events. In this study, 64 older adult subjects (age 65+) were randomly assigned to either a segmenting or a non-segmenting condition. All participants watched four short videos of a person engaged in everyday activities on a computer screen. Participants in the segmenting condition were asked to press the spacebar whenever they identified a small unit of activity during the video. Participants in the non-segmenting condition passively watched. Subjects in both groups then completed free recall, recognition, and order memory tests to assess their recollection. We hypothesized that asking participants in the segmenting condition to explicitly identify event boundaries would lead to better memory. If overt event segmentation is shown to yield better memory results in older adults, instructions and/or training could be considered to see which manipulations help these adults learn to segment more effectively, and therefore remember, everyday events in a real life setting.
Application of $^{31}$P Solid-State Nuclear Magnetic Resonance to Support Regulation of FtsZ in *B. subtilis*

*Megan Lane*

*Mentor: Jacob Schaefer*

Bacterial cell replication requires proteins necessary not only for genome replication, but also those involved in dividing cellular contents. FtsZ, a GTPase that assembles into a multi-protein ring at the site of cytokinesis is essential for proper division of bacterial cells. The Levin lab has discovered that under nutrient rich conditions, FtsZ formation is inhibited, and cells replicate at a faster rate and are abnormally larger. Specifically, the Levin lab has discovered that the protein UgtP may inhibit formation of the FtsZ ring. UgtP’s substrate is UDP-glucose, which is a modified glucose molecule, suggesting that nutrient rich media with more glucose will have increased levels of UDP-glucose and UgtP. With increasing amounts of UgtP, there will presumably be more interference with the formation of the FtsZ ring, and in turn, larger cells. On the other hand, UgtP is an enzyme that is essential in the biosynthesis of lipoteichoic acid (LTA). Thus, by quantifying the amount of LTA, one can indirectly monitor the concentration of UgtP.

By utilizing $^{31}$P solid-state nuclear magnetic resonance, the Schaefer lab has been able to quantify relative amounts lipoteichoic acid on the membrane surfaces of *B. subtilis* grown under different media conditions; thus, NMR may be able to provide insight into the connection between nutrient levels in media, amount of UgtP, and observed cell size. We expect to observe a larger amount of lipoteichoic acid on the surface of cells grown in nutrient rich media compared to that of nutrient poor media. Such results would support the proposal that UgtP is present in larger amounts in nutrient-rich media, which inhibits FtsZ ring formation and result in larger cells.
It has been speculated that violet cone photoreceptors mediate the magnetic sense in chickens; a conclusive test for this suggested pathway would be to test chickens lacking violet photoreceptors for magnetoreception. The goal of this project was to use a violet photoreceptor-specific promoter to drive the expression of the diphtheria toxin (DT) gene solely in chicken violet cone photoreceptors, killing those cells and selectively eliminating the violet photoreceptor cell population. A plasmid containing the DT gene was co-electroporated into dissected embryonic chicken retinas with a loading control plasmid constitutively expressing DsRed (a red fluorescent protein) and a reporter construct expressing GFP, driven by the same violet cone-specific promoter. Mixed results were achieved; while the normalized GFP expression level did not significantly decrease, a decrease in fluorescence was observed for both the loading control and the reporter construct. These results may be attributable to leakiness in the promoter, resulting in widespread expression of DT and subsequent cell death.
Seeing Through the Purple Haze: Searching for Thorium and Silicic Volcanism Anomalies on the Moon

Christopher Lauber

Mentor: Brad Joliff

It is known that there is a correlation between remotely sensed thorium hotspots and silicic volcanism on the lunar surface. However silicic volcanic features are rare on the Moon, judging by those for which we have firm evidence. Features such as the Mairan Domes, Hansteen Alpha, Gruithuisen Domes, Aristarchus Crater, and the Compton-Belkovich volcanic complex all have one thing in common: close proximity to a prominent thorium anomaly or hotspot. These large and prominent geologic features are readily observed in orbital images and in some cases, they have dome-like volcanic shapes that reflect their silicic compositions. With the recent and ongoing Lunar Reconnaissance Orbiter (LRO) high-resolution imaging, we can now extend identification and knowledge of these unusual volcanic features to smaller and more subtle features. Using images from the LRO’s Narrow Angle Camera (NAC), we can now identify small domes and mounds of just a few hundred m to km scales. We can then investigate some of the more subtle variations in the much coarser thorium gamma-ray data from the 1998 Lunar Prospector mission. When viewing images of the Moon overlaid with this dataset, the major thorium anomalies are readily observed, all of which are well documented and include the aforementioned silicic volcanic occurrences. To find other occurrences of silicic volcanism that may be much smaller and less prominent I use a “data rescaling” approach to examine the more subtle, small scale thorium enhancements. Using this approach combined with the new high-resolution imaging I have investigated less-intense thorium hotspots located across the Moon and found several of them to correlate with small features whose morphologies are consistent with silicic volcanism, extending our knowledge of where on the Moon these features occur.
About 20-30% of cases of Multiple Myeloma, a cancer of immunoglobulin producing plasma B-cells, are associated with a chromosomal translocation that ultimately leads to overexpression of the Wolf-Hirshhorn Syndrome Candidate 1 gene (*WHSC1*). Encoded within *WHSC1* is the MMSET protein, a histone methyltransferase, that can be successfully knocked down through short hairpin RNA (shRNA) interference. Knockdown of MMSET leads to decreased cell viability, suggesting a significant role in oncogenesis. Also found within *WHSC1* is a noncoding RNA (ncRNA), ACA11, found to associate in a protein complex involved in relieving oxidative stress. Motivated by the close genetic linkage of the MMSET and ACA11 genes, this study set out to answer the question of whether a direct association existed between ACA11 ncRNA transcript and MMSET protein levels. If such an association existed, we would expect a decrease in MMSET expression levels to be accompanied by a parallel decrease in ACA11 levels.

Our data revealed a 24.4% decrease in ACA11 level of one sample and .28% decrease in another when compared with the control. This data shows that while the two shRNA candidates chosen decreased MMSET protein expression levels, we did not see a parallel decrease in ACA11 levels in one of the samples, as would be expected from a direct association between the two genes, indicating a much more complex relationship, perhaps through intermediate interactions with miRNAs. Further study is required to determine the exact nature of the relationship.
Many athletes that have been subjected to multiple concussions over an extended period of time have developed progressive neurological deterioration known as chronic traumatic encephalopathy (CTE). CTE is characterized by extensive tau, a microtubule associated protein, pathology localized around blood vessels and the depths of the sulci. In CTE and other tauopathies, it is thought that tau function is compromised due to tau hyperphosphorylation, which lowers the binding affinity of tau to microtubules. Humans express six tau isoforms from the splicing of exons 2, 3, and 10. Isoforms are classified as either having 3 or 4 carboxyl terminal microtubule binding repeats (R) depending on the inclusion or exclusion of exon 10. There is equimolar 3R and 4R tau isoforms in normal humans yet it is interesting to note 4R isoforms have greater affinity for microtubules than 3R isoforms. It is possible that the disruption of the 4R/3R ratio is responsible for negative outcomes and pathology in people with CTE and other tauopathies. In this experiment, we looked at transcription, which is upstream of post-translational modifications such as hyperphosphorylation, to see if the cause of disease can be linked to gene expression. We found that injury did not change the expression of tau or the levels of 4R and 3R isoforms in this model. Therefore, it is possible that gene transcription after injury has no effect on the development of CTE, thus further resources should be invested in analyzing how the post-translational modifications of tau result in disease.
Fruit flies display a wide variety of behaviors, including courtship, aggression, and sleep. When pairs of male flies were placed in circular arenas with fly food at the center, a portion engaged in bouts of aggression that established a dominance relationship. Following overnight incubation in arenas with their male partner, flies were again tested for dominance; some pairs maintained their original dominance relationship even after periods of planned perturbation. The existence of this dominance relationship implies that a memory is formed and maintained. Previous research from the Shaw lab has demonstrated that sleep is involved in the consolidation of a long-term memory. Thus, we predicted that sleep could act as a mediator to maintain the dominance relationship. We used the GAL4/UAS transcriptional activation system to induce sleep on-demand in flies following the establishment of a dominance relationship. After sleep induction, flies were tested with their original partners or naïve males. Surprisingly, in two trials with the same partners, a percentage of submissive flies changed their dominance status. This finding suggests that sleep may serve to promote behaviorally adaptive responses following environmental challenges.
Pten and Arf are two tumor suppressor genes frequently mutated in cancer such as Glioblastoma multiforme, the most aggressive type of primary brain tumor. Previous studies have shown that Arf senses oncogenic signals and keeps messenger RNA (mRNA) translation under control. In addition, the absence of Pten activates the mammalian target of rapamycin (mTOR) signaling pathway, which regulates translation. In this study, we investigated another potential aspect of Arf- and Pten-regulated translation in astrocytes: microRNAs (miRNAs). MicroRNAs are 20-22 nucleotide long molecules that degrade mRNA by base pairing with their 3’ Untranslated Region. We used Cre-Lox recombination to create specific gene knockouts in astrocytes freshly isolated from 1 or 2 day-old mice. Through Western Blot analysis, we found that loss of Pten or Arf led to increased levels of Drosha, an RNase III enzyme involved in the processing and maturation of miRNAs. In addition, the loss of Arf caused an increase in the level of DEAD-box protein 5 (DDX5), an RNA helicase shown to regulate miRNA levels in breast cancer. Thus, we hypothesized that the absence of Arf or Pten affects the levels of miRNAs, which in turn alter regulation of mRNA translation in astrocytes. We performed an ABI TaqMan MicroRNA Array to measure 381 mouse miRNAs and controls and found ten miRNAs whose levels changed when Pten, Arf, or both tumor suppressors were knocked out. Currently, we are in the process of validating the results of the microarray. Our results may lead to the development of novel methods in the treatment of gliomas, the most common type of brain tumor.
Looking Glass: Redesigning Remix

Michael Liu

Mentor: Caitlin Kelleher

Remix is one feature offered by Looking Glass, an integrated developing environment, which allows users to learn through the reuse and modification of code written by other users. The remix process creates a relationship between two worlds through the animation that was taken from one and put into the other. The current Looking Glass community lacks a visualization of the remix relationships. Designing a clear visualization of this relationship can assist non-programmers in understanding remix and its uses, increasing their ability to search for and learn from reusing code.
Geologic carbon sequestration (GCS), which involves the injection of atmospheric CO$_2$ into deep saline aquifers, is a promising solution to the alarming increase in global atmospheric CO$_2$ levels over the past 100 years. To evaluate its potential effects on the surrounding rock formation and stability, we must gain more understanding about the rates and mechanisms of mineral dissolution. Here, we investigate the effect of a low pH, aqueous, batch setting on the dissolution rates of various compositions of feldspars. Through the experiment, we find that total concentrations of dissolved minerals, primarily aluminum and silicon, increases over time before it tapers off at high levels. The tapering off may be due to an overall increase in pH in the system as cations are released from the minerals, which consume protons. There is evidence to show that, at low pH, a direct correlation exists between acidity of the environment and dissolution rate of the minerals. Additionally, we determined that an increase in anorthite content of the feldspar induces an increase in dissolution rate of the mineral. The effects on the dissolution rates is most likely due to changes to the form of T-O-T linkages and the average length of T-O bonds. These changes occur due to protonation of the Al-O-Si linkages and shifts in ionic charge of increasing anorthite content in feldspar. The results from this experiment will help us better understand the mechanisms behind feldspar dissolution, which allows us a clearer picture on potential effects on the rock formation during GCS.
Meningiomas are the most common primary brain tumors. Although the majority are benign, up to 30% are malignant and are associated with detrimental effects on both morbidity and mortality. The standard treatment for these tumors is surgery and/or radiation, but for recurring or aggressive tumors, no effective therapies are available for their treatment. Retinoids have been used with efficacy in a variety of tumor types. Their roles as differentiating agents are particularly appealing for childhood and brain tumors, and have been proposed, but not well studied in meningiomas. Fenretinide is a novel retinoid, in that unlike other agents, it has been demonstrated to induce apoptosis in cancer cells (e.g. leukemia, neuroblastoma and lung cancer). In addition, this retinoid has a favorable side effect profile. We propose to characterize the effects of fenretinide on the viability and radiosensitivity of meningiomas. We utilized three immortalized cell lines in our experiments, including IOMM-Lee, HeLa and SF3061 cells. We performed in vitro cellular assays to study the effects of varying concentrations of fenretinide in several key aspects of meningioma tumor biology. Our studies demonstrated that fenretinide has the ability to halt cell proliferation in a dose-dependent manner at physiologically relevant drug levels. Fenretinide in combination with radiotherapy had no effect on the capacity of meningioma cells to grow into colonies and in some cases, increasing doses of fenretinide resulted in radioprotection. Finally fenretinide did not seem to have much of an effect on the cell cycle of the meningioma cells. These results, suggest that fenretinide might be useful in treating meningiomas, but that care may be required to determine the best timing in association with radiation. Future studies will involve studies of the impact of fenretinide on cellular invasion, within an in vivo model of meningioma, and a phase I/II trial in meningioma patients.
Wavelets are mathematical functions used to decompose data into its constituent frequencies. One takes a function satisfying certain properties, called a mother wavelet, and represents an arbitrary function as an infinite sum of dilations and translations of the mother wavelet. In practice, one truncates this series at an appropriate point to obtain an approximation to the original function with many desirable properties. Wavelets can be considered a vast generalization of the theory of Fourier series, which applies only to periodic functions. The theory of wavelets plays an important role in both pure and applied mathematics. Wavelets are of theoretical importance for their deep connections to both harmonic and functional analysis. For example, they can be used to give interesting characterizations of many common function spaces. Their applications to signal processing are innumerable. Most notably, wavelets form the theoretical foundation of the JPEG2000 image compression standard and the digital fingerprint image compression standard used by the FBI. Here we investigate the connectivity of wavelets and attempt to determine if there exists a smooth interpolating path between any two wavelets. This question was answered affirmatively in the case of wavelets arising from a multiresolution analysis with scaling functions of polynomial decay by Bonami, Durand, and Weiss in 1996, and then affirmatively for all multiresolution analysis wavelets by the Wutam consortium in 1998. We discuss these approaches and explore ways to extend them to larger classes of wavelets.
Toward a Better Understanding of...

**Swell-Activated Chloride Channel Block Causes Significant Decrease in H148Q Fluorescence in Mammals**

*Melany N. López*

**Mentors: Stephanie Stotz and David Clapham, Harvard Medical School**

Swell-activated chloride channels (Clswell) are important regulators of cardiac function, modulating cardiac electrical activity, myocyte volume regulation, and apoptosis. Activation of the swell-induced chloride current (IClswell), causes a slight depolarization of the resting membrane potential in cardiac cells, and a shortening of the action potential, suggesting that IClswell could be involved in cardiac arrhythmias.

The gene responsible for this protein remains unknown, and this project sought to create a screen in order to determine the Clswell protein in mammals by analyzing the current through this channel (IClswell). Using HeLa cells and time-course fluorescence assays, we determined that pharmacological block of Clswell channels and siRNA knockdown of Clswell channel modulators prevent a significant decrease in H148Q fluorescence, setting the foundation for the creation of an RNAi screen to determine the IClswell channel in mammals.
Axon degeneration is characteristic of many neurodegenerative disorders, including glaucoma, chemotherapy-induced neurotoxicity, and diseases such as Alzheimer’s and Parkinson’s. This axon degeneration, also known as Wallerian degeneration (WD), describes the degeneration of axons distal to the site of injury. By understanding the molecular pathways of WD, we hope to identify potential therapeutic targets for preventing axon degeneration in injury and disease. Using *Drosophila melanogaster* as the model organism, a simple axon damage assay can be used to investigate this degeneration pathway.
Toward a Better Understanding of…

Synthesis of 3-(3-amino-1-naphthyl)-alanine

Norman Luc

Mentor: Steven Kinsley

3-(3-amino-1-naphthyl)-alanine is a chiral α-amino acid that has been reported to show separation on paper chromatography, a property that can aid organic chemistry laboratory students in discovering the concept of chirality. The first step of the synthesis, the nitration of 1-methylnaphthalene, was carried out using nitric acid and a reusable lanthanum (III) triflate catalyst, avoiding harmful reagents and waste products. Other steps contributing to the synthesis were partially tested, namely the reduction of the nitrated product by ammonium formate with a zinc catalyst, and the bromination of the same nitrated product by N-bromo-succinimide. The synthesis has been successful thus far with green chemistry procedures, and work will continue on the synthesis to produce the target molecule.
Examining Parental Interactions with a Childhood Community Nutrition Project in Naigobya, Uganda

Eli Madden

Mentor: Bradley Stoner

The rural village of Naigobya, Uganda has a prominent, well-established non-governmental organization (NGO) known as Uganda Development Health Associates (UDHA). This NGO is a grassroots organization that works to improve the health of underserved communities. The main focus of the Naigobya branch of UDHA is a childhood nutrition program, incorporating education, community health workers, and a community garden to empower young Ugandans to improve their health by improving their nutrition. It is hoped that by fostering healthy lifestyles now, they will become routine for future generations. Preliminary research by a past intern for UDHA found that some parents, particularly fathers, seemed disinterested or unknowledgeable about the UDHA nutrition program. This intern spent some time interviewing the locals in the village about the programs at UDHA and found this common trend but did not learn the reasons behind this disinterest. This summer I engaged in participant observation in an attempt to understand this phenomenon. I lived in Naigobya, and worked with the project, while conducting semi-structured, open-ended interviews with fathers and mothers of children in the village. Results showed extreme interest in the project, but structural issues that caused fathers to miss programs or community sensitizations. Additionally, women expressed an increase agency within the traditional family structure of Uganda when they participated in the program. The information gathered in this study has the potential for use in other initiatives that UDHA undertakes, and I hope to work with the NGO to maximize the benefit of the project in the future.
Toward a Better Understanding of...

**Global Transcriptome Analysis of Response to Uropathogenic *E. coli* Infection in a Murine Menopause Model**

Emily Ma

Mentor: Indira Mysorekar

Urinary tract infections (UTIs), which are primarily caused by uropathogenic *Escherichia coli* (UPEC), annually affect over 150 million patients worldwide. Despite efforts with antibiotic therapies, women, particularly post-menopausal women, frequently suffer from recurrent and persistent UTIs, suggesting that estrogen status is a risk factor. Previously, our group showed that estrogen status alters the normal course of infection. The objective of this project was to determine how estrogen status governs susceptibility to UTIs and which molecular signals were specifically responsible for mediating the estrogenic control. We used a mouse model of surgical menopause to mimic the estrogen levels found in post-menopausal women (OVX); control animals pre-menopausal (SHAM). To identify the genes responsible for the differences seen in SHAM mice and OVX mice during a UTI, we performed global gene expression analysis using Illumina DNA microarray analysis. Next, using Ingenuity Pathway analyses, I identified ten pathways and associated genes which were most affected by ovariectomy in response to UPEC infection. These included genes modulating immune response, cytoskeletal remodeling, and stem-cell regulatory pathways (WNT) pathways. Finally, I used quantitative real time PCR validation analyses to demonstrate that IL-17, CD44, and Tcf19 expression displayed significant differential regulation by estrogen. Thus, my findings reveal that a menopausal state, i.e., estrogenic deficiency particularly affects genes involved in both inflammation and epithelial stem-cell regulation in the bladder in response to UPEC infection. By identifying the genes responsible for the differences in non-menopausal and menopausal females, we hope to elucidate the mechanisms underlying these differences and establish a link between basic science and clinical practice to better address the clinical burden of UTIs in post-menopausal women.
Gastric cancer is the second most common cause of death from cancer in the world, and its causes are thought to include helicobacter pylori infections, sanitation, genetics, and diet. Our laboratory is interested in identifying genes important for defining differentiation of mouse stomach cells in normal and metaplastic models to better understand gastric cancer. Mindbomb1 (MIB1) is an E-3 ubiquitin ligase that is downstream of the known transcription factor MIST1, and is crucial to functional and morphological changes in cells in the gastric unit as they differentiate from their precursors. We sought to determine whether MIST1 expression is dependent on the expression of MIB1. We used a variety of techniques such as Western Blot analysis using MIB1 deficient mouse stomach protein with MIST1 antibodies, transfecting HCG cells with MIB1 siRNA and using these cells to obtain cDNA in order to run a PCR reaction, and analyzed the expression of MIST1 with fluorescent immunohistochemical staining on MIB1 deficient stomach slides (from mice) with MIST1 antibodies. Analysis from fluorescent immunohistochemical staining results confirmed that MIST1 expression is not dependent on MIB1 expression, as MIST1 was still expressed in zymogenic cells. The Western Blot and transfection experiments were unsuccessful in confirming the results from the fluorescent immunohistochemical staining. In future experiments modifications in the current protocols will be made to hopefully yield meaningful results to further define the connection between MIST1 and MIB1 expression.
Toward a Better Understanding of...

Effect of Elevated Levels of Epidermal Thymic Stromal Lymphopoietin on Skin Tumorigenesis

Sindhu Manivasagam

Mentor: Raphael Kopan

Thymic Stromal Lymphopoietin (TSLP) is a cytokine mediated in T helper 2 (Th2) cell immune responses. In published literature, increased levels of TSLP have been shown to promote tumor growth in breast and pancreatic cancer via promotion of Th2 inflammation. However, in studying animals with Notch signaling deficiency in the skin, our lab saw that the high levels of TSLP released by their epidermis cause a tumor protective phenotype. Therefore, the purpose of this project was to investigate the role of high TSLP levels in the skin. We have demonstrated that this tumor protective phenotype, in Notch deficient skin, is caused by TSLP and is mediated through CD4+ T cells. Furthermore, we analyzed the effects of TSLP overexpression in wild-type skin. This was done using a topical application of calcipotriol, a vitamin D analog, to induce epidermal TSLP expression in wild-type mice. These mice were then subjected to a standard skin chemical carcinogenesis protocol. Results from these experiments show that TSLP overexpression prevents skin tumorigenesis in wild type mice as well. These findings show that TSLP may have the potential to be used as a novel anti-cancer therapeutic agent.
Research on the importance of innovation in businesses is growing, but there are still many gaps in the evidence. Innovation is extremely difficult to measure and there is no commonly accepted method to do so. Many factors influence an organization’s ability to adopt new innovations, both controllable (internal) and non-controllable (external). This project aims to explain the benefits of making innovation a priority in the workplace and detail certain attributes that can enhance or inhibit innovation. To accomplish this I discerned factors influencing innovation adoption in the published literature and compared those factors to first hand data from innovation professionals, gathered via in-person interviews. After drawing comparisons and highlighting discrepancies between these two sources I identified six key factors that influence innovation adoption: 1) communicability, 2) targeting, 3) awareness, 4) change-oriented thinking, 5) support of management, and 6) employees on board. Implications of this research suggest that innovation adoption is the combination of many different factors, some more easily controlled and some not. Managers should focus on factors they have the power to change, such as making an innovation easily communicable. Innovations are more easily adopted if they become a part of company culture, which is more likely to occur if both the management and employees buy into the new idea. Innovation is necessary to keep a company competitive, but it is only helpful if both the organization and its employees genuinely want to change and are ready to take on that challenge.
Toward a Better Understanding of...

Development of Software for Characterization of Local Atomic Structures in Amorphous Metals Via Weighted Voronoi Diagrams

Zachary E. Markow

Mentor: Kenneth F. Kelton

Metallic glasses have unique properties that hold great promise for engineering applications. To harness this potential, it is critical to advance the understanding of the links between metallic glasses’ volume properties and nanoscale atomic structures. However, the characterization of these structures is not straightforward; the atomic configurations of metallic glasses are disordered or amorphous compared with the regular atomic structures of crystals, which possess long-range periodicity. A weighted Voronoi diagram (abbr. WVD) is a descriptive, chemically specific, precise tool available for characterizing short-range atomic configurations in amorphous materials. Mathematically, an unweighted Voronoi diagram (abbr. UVD) is the set of minimum-volume polyhedra whose faces are formed by the perpendicular bisector planes between pairs of atoms. Each type of WVD that we use is essentially a UVD in which these planes are shifted to adjust the volume and shape of each polyhedron according to the size of the enclosed atom. Unfortunately, current approaches that construct Voronoi diagrams are insufficient for our needs. For this reason, we have developed our own program to study the local atomic structures of metallic glasses via WVDs. This program was tested extensively on crystalline lattices with known structures, and the expected output data were produced. Presently, our program is being tested on previously studied amorphous materials, and the preliminary results from these tests suggest that our program will likely soon be ready to analyze never-before-studied metallic liquid and glass samples.
China’s economic growth will affect the world in profound ways because of its increasing demand for energy and raw materials. The country has 1.3 billion people and in order to satisfy the needs of its population it must search continuously for resources throughout the world. Chinese corporations and government owned companies are involved in the economic affairs of five republics of central Asia: Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan, and Uzbekistan. Central Asian states possess abundant supplies of natural gas and oil. Current scholarship on Central Asia speaks of the emergence of a “New Great Game,” where great and regional powers such as the United States, China, Russia, Turkey and Iran engage in rivalry and competition over resources. This research challenges the concept of the “Great Game.” The original “Great Game” was simply a struggle for political domination and territorial control between Russia and Britain in Central Asia in the nineteenth century. However, the original meaning of the phrase has been lost. I believe such terminology maintains the possibility of masking the significance of today’s realities in Central Asia. A major component in China’s plan to transition to the modern world is expansion into Central Asia. Contrary to conventional wisdom, China’s objective in Central Asia, particularly Kazakhstan, is not to engage in a great game with other regional powers but to secure regional states’ support in suppressing Uighur nationalists, and to facilitate Chinese investment in Kazakhstan’s energy resources.
Toward a Better Understanding of...

**Kinematic Analysis of Forefoot Deformity in the Diabetic Neuropathic Foot**

*Joseph McDonald*

**Mentor: Mary K. Hastings**

Diabetes mellitus and peripheral neuropathy (DMPN) can result in biomechanical impairments of the foot that may contribute to joint deformity, ulcer formation, and amputation. Current three-dimensional kinematic models used to study foot motion are limited to rearfoot, forefoot, and great toe comparisons, yet much of the forefoot deformity resulting in ulcer formation is related to second metatarsal movement. The purpose of this study is to build a multi-segment foot model that incorporates the metatarsal bone to further explore kinematic differences in people with DMPN and forefoot deformity.

An eight-camera, Vicon 3D motion capture system and force plate were used to track 28 reflective markers on key joints and anatomical landmarks on the foot, establishing axes to determine relative segment motions. Vis3D software was used to define the motion segments of the leg, foot, and toes which allows us to graph joint motion through space during activity performance (e.g. walking, heel rise).

During recorded activities, we observed that forefoot (hammer toe) deformity was associated with several biomechanical impairments: metatarsophalangeal joint flexion and ankle dorsiflexion range of motion deficits, a sustained supinated foot type, and decreased ankle power generation. This data with additional analysis allows us to form a model that will help us understand where high plantar pressures are most likely to occur. Future plans include integrating kinematic data with plantar pressure data and engineering a streamlined process to export data from Vis3D software into graphing templates and statistical software making data analysis more efficient and user-friendly. This knowledge can help clinicians develop strategies to prevent ulcers that otherwise may require amputation.
Degeneration of the axon, the central projection of the neuron that allows it to communicate with other neurons, is a common mechanism that underlies a wide range of diseases, from glaucoma to Parkinson’s disease. A potential pathway involved in this process is one where dual leucine kinase (DLK), a mitogen-activated protein kinase kinase kinase (MAP3K), acts through a MAP2K to activate c-jun N-terminal kinase (JNK), a MAPK. Previous work has shown that DLK-deficient axons have delayed degeneration after an insult such as axotomy compared to wild-type controls. Inhibiting c-jun N-terminal kinase (JNK) at the time of axotomy has also been shown to delay axon degeneration, both consistent with a DLK-dependent axon degeneration pathway. The details of which MAP2Ks and which subsequent JNK isoforms are activated downstream of DLK, however, is not yet known.

To determine this, I infected cultured dorsal root ganglion cells (DRGs) from mice with shRNAs for the different JNK isoforms and monitored their degeneration at several time points after axotomy. Of the shRNAs tested, shRNAs against JNK2 protected axons against degeneration. qPCR also confirmed that JNK2 mRNA levels were effectively knocked down for each shJNK2 construct. ShRNAs for JNK1 and JNK2, however, failed to show a clear correlation between isoform knockdown and level of protection. Likewise, shRNAs that knocked down the MAP2K MKK4 delayed axon degradation after axotomy whereas shRNAs effectively targeting MKK7 did not. These results suggest that MKK4 is the predominant MAP2K acting downstream of DLK that then activates JNK2 in an axon degeneration pathway.
Toward a Better Understanding of...

**The Effects of Polycystic Ovarian Syndrome on Implantation**

*Jessica Minor*

*Mentor: Kelle H. Moley*

Polycystic ovarian syndrome (PCOS) is the most common cause of infertility among women of reproductive age, with an incidence reported as high as fifteen percent. Though oligo- or anovulation in women with PCOS may contribute to infertility, attempts to overcome these abnormalities through *in vitro* fertilization (IVF) have yielded poor success rates. This suggests that adverse endometrial receptivity accompanying the clinical state of women with PCOS may contribute to infertility. In this study, we hypothesized that endometrial stromal cells (ESCs) of women with PCOS may show impaired decidualization. Decidualization refers to the change in morphology and expression profile of ESCs upon exposure to progesterone, as during pregnancy.

ESCs were isolated from 4 women diagnosed with PCOS and 14 clinically normal, fertile controls. The ESCs were decidualized *in vitro* with a synthetic variant of progesterone, and tested for known markers of decidualization, including insulin-like growth factor binding protein-1 (IGFBP-1), interleukin-15, and prolactin. Our results showed no difference between PCOS patients and controls. This may suggest that endometrial receptivity may be affected by factors within the uterine environment, including circulating androgens and unopposed estrogen action on the endometrium. Complications due to obesity, which is found in fifty percent of women with PCOS, may also reduce fertility. This research contributes to our understanding of the mechanisms of infertility in women with PCOS, and informs approaches to fertility treatment.
Myelodysplastic syndromes (MDS) are heterogeneous disorders of the bone marrow marked by ineffective hematopoiesis, and progress to highly chemotherapy-resistant secondary Acute Myeloid Leukemia (sAML) in up to 30% of patients. Identifying predictive biological markers that denote those higher risk cases of MDS that will transition into sAML is imperative to develop more effective therapies for the disease. Last year, we identified novel missense mutations in \textit{U2AF1} using whole genome sequencing in patients with MDS. \textit{U2AF1} is a subunit of the U2 small nuclear riboprotein auxiliary factor recruited to the spliceosome complex that mediates pre-mRNA splicing. The mutations occur at a highly conserved site in codon 34 [changing serine to phenylalanine (S34F) or tyrosine (S34Y); 1 patient with S34F had an additional missense mutation on the same allele (Q157R)] in ~9% of patients with MDS. Pre-mRNA splicing is an essential, highly regulated posttranscriptional process in which noncoding intronic sequences are removed from pre-mRNA and exonic sequences are spliced together, resulting in the production of specific protein isoforms. Alternative splicing allows a single gene to express many different protein isoforms through the implementation of alternative 5’ and 3’ splice sites, the retention of introns, or the aberrant retention or skipping of exons. Pre-mRNA splicing is a ubiquitous eukaryotic cellular process, and modifications or dysfunction in this pathway could lead to expanded genetic diversity in cancer cells and disease. We hypothesize that \textit{U2AF1} missense mutations alter pre-mRNA splicing in MDS as a potential mechanism for MDS pathogenesis. We utilized \textit{GH1} and \textit{FMR1} minigene assays (well characterized systems to measure alternative splicing) and reported that S34F-mutated \textit{U2AF1} promoted enhanced exon skipping in \textit{GH1} and cryptic splice site usage in \textit{FMR1}, resulting in enhanced alternative splicing. We extended this analysis to include additional \textit{U2AF1} mutations not previously investigated and new mutations discovered by other groups—S34Y, S34F/Q157R, Q157R, and Q157P. We now show that S34F-mutated \textit{U2AF1} displayed the most profound alternative splicing phenotype for both \textit{GH1} and \textit{FMR1}, with modestly enhanced alternative splicing by S34Y-mutated \textit{U2AF1}. Conversely, Q157R and Q157P-mutated \textit{U2AF1} both significantly enhanced splicing of the canonical isoforms of \textit{GH1} and \textit{FMR1}. The S34F/Q157R allele displayed an intermediate splicing phenotype. With S34F-mutated \textit{U2AF1} displaying the most profound alternative splicing phenotype, we are currently performing whole transcriptome analysis to identify additional genes that have enhanced alternative splicing in the presence of S34F-mutated \textit{U2AF1} to further elucidate its role in the pathogenesis of MDS. Understanding the molecular consequences of mutations in splicing machinery may lead to improve therapies for patients with MDS.
This project will employ interviews with individuals of two cultures to investigate the universal claims made by James Fowler regarding his Faith Development Theory. Faith, according to Fowler, is better understood as a relation to the ultimate questions in life or a worldview than as a belief in something. According to FDT, people develop faith through a structural developmental stage theory similar to that of Piaget’s Cognitive Development Theory and Kohlberg’s Moral Development Theory. I will challenge the universality of this stage theory (not of “faith” itself) by interviewing subjects in the U.S. and in a culture foreign to us to determine if FDT can stand the test of cultural impact on faith. Is FDT universal? Will an individual across the globe experience the same progression of stages in her faith as an American? Does a progression of faith stages even exist?
In this study, our aim was to explore the relationship between hippocampal volume and memory in youth. While similar studies have been conducted with whole hippocampal volumes, this experiment makes use of new technology that has allowed for automated segmentation of the hippocampus into its individual subfields. In addition, establishing this relationship in typically developing youth is a necessary step towards exploring differences in patient populations. T1-weighted scans were obtained on a 3 Tesla magnetic resonance imaging (MRI) machine for youth 7-17 years old (n=37). The subjects were administered a verbal list-learning task and a spatial location memory task, both of which had immediate and delayed recall portions. Age did not correlate with total hippocampal (p=0.97) or subfield volumes (all p > 0.62) but did correlate with several measures of spatial memory performance (all p < 0.033). Males had significantly larger total hippocampal volume, subfield volumes, and intracranial volume (ICV) than females (all p > 0.025); but there was no significant effect of gender on memory task performance (all p > 0.36). In a hierarchical linear regression controlling for age, gender, and ICV, larger total hippocampal volume was associated with better delayed verbal retrieval (p = 0.01). In hierarchical linear regressions controlling for age, gender, and total hippocampal volume we found that larger CA2-3 subfield volumes were associated with better immediate spatial recall (p = 0.036) and larger right CA2-3 volumes were associated with better delayed spatial recall (p = 0.036). While conflicting results have suggested different relationships between hippocampal volume and memory in youth, our findings support a “bigger is better” hypothesis, where larger volumes are associated with increased memory performance. Our results introduce information gained from subfield segmentation to existing knowledge and provide a basis for examining a patient population.
Hemophilia B is an inherited blood clotting condition caused by a dysfunctional Factor IX (FIX) protein and is treated with infusions of purified FIX used as a protein-therapeutic. However FIX has an extremely short half-life requiring frequent infusions. Fc-fusion is an established platform technology for extending the serum half-life of protein therapeutics and was used to create a monomeric Fc-FIX fusion protein that is composed of the Fc region of immunoglobulin G (IgG) and recombinant (r)-FIX. Besides the short half-life of therapeutic proteins, the development of inhibitory anti-drug antibodies is an impediment to the successful use of replacement therapy. It has been suggested that an Fc-fusion may, in addition to prolonging half-life, reduce this immunogenicity. Here we evaluate the immunogenicity of a fusion protein generated by the chemical conjugation of Fc to rFIX by Dr. Gouri Pandey and Dr. Ran Zichel. rFIX as well as the rFIX-Fc fusion protein injected by tail vein injection into hemophilia B mice and bleeding time, antibody titer and presence of anti-FIX inhibitory antibody were assessed. Preliminary experiments showed a general trend: rFIX-Fc treatment generates an antibody titer significantly larger than that created by rFIX treatment. Notably, rFIX treatment, seems to generate more inhibitory antibodies whereas, rFIC-Fc treatment seems to generate less. We hypothesize that the rFIX-Fc construct may conceal “preferential” epitopes needed to trigger immune response against rFIX or that immune system suppression may be implicated. Future studies using a larger cohort of Hemophilia B mice are needed to substantiate the above theories.
Toward a Better Understanding of…

Reconsidering American Higher Education

Daniel Myerson

Mentor: John Doris

Undergraduate enrollment in American colleges and universities is higher than it has ever been. Considering the steeply rising enrollment, the ever inflating cost of attending, and their critical role in the discovery and dissemination of knowledge, it seems incumbent upon our students, professors, parents and society to reanalyze American institutions of higher learning. The aim of this work is to facilitate such an analysis by asking certain fundamental questions, such as: what do we want our undergraduates to be getting out of their college experience? Are they, in reality, reaching these goals? Can we do something to expedite or improve the process? The project investigates these questions by reviewing eminent works in an emerging field called “Critical University Studies,” which seeks to critically assess the frameworks, assumptions and institutions of American higher education. Specifically, I review six books: Academically Adrift (Arum and Roksa, 2011), Higher Education? How Colleges Are Wasting Our Money and Failing Our Kids—and What We Can Do About It (Hacker and Dreifus, 2010), Not For Profit: Why Democracy Needs the Humanities (Nussbaum, 2010), The Fall of the Faculty: The Rise of the All-Administrative University and Why It Matters (Ginsberg, 2011), We’re Losing Our Minds: Rethinking American Higher Education (Keeling and Hersh, 2011) and What the Best College Teachers Do (Bain, 2004). Though the authors reviewed in the work disagree on a number of issues, all unanimously believe that we must reconsider the status and purpose of American higher education, lest we lose control of this critical institution. It should be noted that the research presented is incomplete and will continue throughout the 2012-2013 school year.
Thymosin beta 4 (Tβ4), a G-actin sequestering peptide promotes oligodendrogenesis. Quantitative real time PCR (qrtPCR) and Western blot data demonstrated that Tβ4 treatment upregulated the expression of myelin genes (i.e. markers of mature oligodendrocytes) e.g. myelin basic protein (MBP) and 2',3'-cyclic nucleotide 3’-phosphodiesterase (CNPase) at mRNA and protein levels in a dose dependent manner in rat SVZ cells and mouse N20.1 cells. To determine molecular mechanism of Tβ4 mediated oligodendrocyte differentiation, p38 mitogen-activated protein kinase (p38MAPK) signaling pathways which regulate oligodendrocyte myelin gene expression were investigated. QrtPCR and Western blot data showed significant induction of both expression and phosphorylation of p38MAPK and simultaneous inhibition of phosphorylation of extracellular signal regulated kinase (ERK), c-Jun N-terminal kinase 1(JNK1) and expression and phosphorylation of c-Jun after Tβ4 treatment and reversal of these effects after Tβ4siRNA transfection. As c-Jun is a potent transcription repressor of myelin gene promoter, reduction of expression and activation of c-Jun activated myelin gene promoter and induced myelin gene transcription after Tβ4 treatment. Sequential immunoprecipitation and Western blot indicated that lack of F-actin after sequestering G-actin by T 4 treatment induced protein-protein interaction between integral membrane proteoglycan NG2 and receptor of platelet derived growth factor-α (PDGFRα) and reduced protein-protein interaction between NG2 and F-actin. These data indicate that Tβ4 mediated NG2-PDGFR interaction blocked Ras/Raf/Mek/ERK signaling pathway, inactivated c-Jun and activated transcription of MBP and CNPase mRNAs in a novel molecular mechanism via protein-protein interaction among Tβ4, actin, NG2 and PDGFRα. Tβ4 treatment therefore induces oligodendrocyte differentiation, and shows potential as a therapeutic approach for the treatment of demyelinating diseases such as multiple sclerosis.
Toward a Better Understanding of...

Gain and Loss Processing in Healthy Children: An Investigation of The Effects of Anhedonic Symptoms and Individual Differences on a Signal-Detection Task

Jamie Neiman

Mentor: Deanna Barch

Anhedonia (reduced responsiveness to pleasure) is an important feature of depression, yet the behavioral and neural underpinnings of this symptom are not fully characterized. Several behavioral paradigms, including a probabilistic reward task developed by Pizzagalli et al, have been designed to characterize responses to reward feedback in adult populations. Healthy, hedonic adults display a shift in choice behavior toward a “rich” stimulus over the course of a task. However, depressed adults, as well as healthy adults with higher anhedonic symptoms, fail to develop a strong bias in their responses.

Pizzagalli’s task specifically demonstrated reward responsivity in adults. The motivations of this study were to demonstrate both reward and punishment responsivity across a developmental spectrum. The aim was to determine if children with anhedonia specifically struggle with reward processing, reward and punishment processing, or learning in general. To assess a developmental component of reward and punishment responsivity in relation to anhedonic symptoms, the task was modified to display stimuli for a longer period of time and have fewer trials in task blocks, and was then administered to children aged 7 to 10 to determine if the task would elicit reward and punishment responsivity in kids. Twenty-nine healthy children and their parents completed self-report measures to assess levels of depressive and anhedonic symptoms.

Children developed strong biases toward the rich stimulus across both reward and punishment blocks of the task. Moreover, anhedonic symptoms negatively correlated both with change in response bias across the punishment version of the task and with response bias at the end of the reward block of the task. Interestingly, this relationship was specific to anhedonia and was not found for depressive or other internalizing/externalizing symptoms. These findings help to characterize anhedonia as a distinctly different phenomenon than depression.
Iron meteorites are made of iron and nickel, and are believed to come from cores of asteroids. Geologists classify iron meteorites into groups that exhibit similar chemical properties and presumably come from the same parent bodies. In this study we measured the Zinc isotopic compositions of 32 iron meteorites from various magmatic and non-magmatic groups. We chose Zn because it is a moderately volatile element, of which important planetary formation processes could fractionate Zn isotopes and lead to mass-dependent isotopic variability. We found that our samples support mass-dependent fractionation by forming a linear trend on the three-isotope plot. The negative correlation between Zn concentration and $^{66}\text{Zn}$ is consistent with mass-dependent evaporation with preferential loss of lighter isotopes. Furthermore, our data on two IVA samples clearly shows that volatiles depletion in IVA parent body could not be due to evaporation. This is important evidence that favors the non-condensation origin of the IVA parent body. Thus comparing the isotope compositions of volatile elements in iron meteorites could help us further our understanding of the physical and chemical conditions of the evaporation process. This knowledge then could be applied to the understanding of the formation of Earth’s core.
Excavations of even the smallest architectural features, such as walls that stand only a meter high, can reveal important implications about the layout of a city and the social and political interactions between people who lived in that area. For this project, excavations were conducted on two separate wall structures located within the civic center of a Maya site, Actuncan, located in the Belize River Valley near the Belize/Guatemalan border. The two walls highlight important sections of the city: the first (named the King Lear wall in the field) forms part of a plaza unit, or open space surrounded by three possibly ritual structures on one side and an elite residence on the other side, while the second (the Scout wall) also encloses a plaza group and a possible ritually and cosmologically significant E Group of structures as well as outlining the edge of the civic center, beyond which lie household groups. For each wall, test units were dug bisecting the walls in order to best approach the front of the walls and gain a better understanding of their construction. Artifacts were sifted through ¼ inch screens and ceramics were collected from the wall fill for dating. Based on preliminary analysis, the King Lear wall may have served to delineate space or block access between the ritual structures and the elite residence. The Scout wall, on the other hand, may have served as a palisade with a perishable wooden or cloth component built up through the middle. The dating results will help to place the construction of these walls within the chronology of other structures in the site and therefore relate their construction to shifting politics within the site.
Interaction of Two HIV Protein Paralogues with DCAF1 and Cyclin L2

Austin Niu

Mentor: Lee Ratner

This research focuses on HIV and associated retroviruses. HIV-2 causes a very mild disease in humans while HIV-1 is responsible for the current pandemic. Both viruses have a parologue of Vpx called Vpr which is believed to be important in HIV pathogenicity. At the cellular level, Vpr and Vpx interact with a DCAF1 (DDB1-CUL4 ASSOCIATED FACTOR 1) which is believed to be essential for their functions. Little is known about these two proteins; hence a screen was performed to look for DCAF1 interacting proteins. The result showed a protein called Cyclin L2 as a novel DCAF1 interacting protein. In response to the screen, a hypothesis was generated that Cyclin L2 would interact with Vpx in the cell. This was tested by creating a cellular environment that would include both Cyclin L2 and Vpx (not the full virus). Cyclin L2 (in plasmid form) was co-transfected with Vpx (also in plasmid form) in increasing dosages into 293T cells which were recovered after 2 days. The Western blot showed that Vpx is degraded by Cyclin L2 in a dose dependent manner. Since DCAF1 is associated with proteasomal degradation of other proteins, we hypothesized that Vpx may be degraded by the proteasome. To test this idea, we did another co-transfection with the addition of the proteasome inhibitor, MG132. The Western blot revealed that MG132 did indeed rescue the degradation of Vpx by Cyclin L2 and showed that the mechanism used by Cyclin L2 to degrade Vpx is the proteosome pathway. Following this, this test will be applied to Vpr during the fall semester to test if Vpr participates in a similar biochemical pathway. Knowledge of the difference between the features of these two proteins is vital to understanding the extreme pathological differences between two nearly identical retroviruses, HIV-1 and HIV-2.
Amid an atmosphere of increasing censorship and intolerance in sixteenth- and seventeenth-century Spain, the apparent anomaly of a royal, religious library accepting Hebrew, Arabic, and forbidden books presents a unique window onto aspects of early modern Spain’s political, cultural, and intellectual life. Moreover, since various kinds of people and books converge in the Real Biblioteca del Escorial, founded by King Philip II in 1559, the library is a useful place to compare the treatment of books (themselves a kind of body) and that of bodies. In fact, I believe that the symbolic significance of textual incorporation and exclusion within the library parallels the human processes occurring with corresponding readers and populations. Reading the library entails an examination of early modern attitudes towards libraries, books, and readers, along with attendant views on censorship, intolerance, and destruction. Additionally, I consider the political-historical context of Spain’s powerful empire and ambivalent attitudes towards Protestants, Jews, Muslims, and their converted but stigmatized descendants. Given these contexts, I examine published and archival Inquisition licenses, catalogues, constitutions, descriptions, histories, and letters regarding the Escorial library in the sixteenth and seventeenth centuries for an understanding of its policies, readers, and book acquisition—paying particular attention to the treatment of suspect books and their readers. From the historical context and documentary evidence, I suggest that keeping “dangerous” books in this library expressed power over the conquered, showed royal pride and prestige through a universal and valuable library, and minimized the risks that the books present by isolating them from all but trustworthy readers. Indeed, although the library was ostensibly open to “all men of letters who wished to come and read,” in the words of Philip II, it appears that only those most trusted readers enjoyed an unusual, potentially dangerous freedom of reading at the Escorial.
Presolar grains survived processing in the hot solar nebula and retain the unique stellar signatures of the stars in which they formed. We analyze the isotopic and elemental characteristics of these grains, and compare the results with data from astronomical spectroscopy to improve models of stellar nucleosynthesis. In particular, we study the Fe isotopes in presolar silicates of size between 100nm and 500nm. The small sizes of the grains prohibits usage of established methods of measuring Fe isotopes. We present an alternative method that uses the same instrumentation but that measures Fe as part of the anion FeO.
This project examines how residents of the capital city of Amman are reacting to government sponsored urban development projects that aim to highlight the heritage and history of the country and city. Government and foreign agencies are forging a distinctive identity for Amman, a city positioned between long-established cities like Cairo and Damascus and newer oil-rich capitals such as Dubai and Doha. This identity is one that emphasizes modernization and heritage. I use Rainbow Street as a site to explore how Ammanis conceive of and interact with this newly renovated public space. The Greater Amman Municipality (GAM) sponsored the renovation of Rainbow Street, formerly known as Abu Bakr Siddiq Street, beginning in 2005. It is a public space utilized by expatriates (NGO workers, students, and teachers), Western and Arab tourists, and Ammanis from various sectors of society. Rainbow Street and GAM are results of a concerted effort of the government and international agencies to attract investment and tourism to Amman. How are these efforts connected to larger notions of state and nationhood? What does Rainbow Street symbolize to the shop owners, employees, customers, drivers, and pedestrians who occupy its space? How do the meanings associated with Rainbow Street influence the public interactions of its occupants? I use textual analysis, street observations, participant observation, and informal, semi-structured, and structured interviews to analyze how inhabitants of Amman are responding to changes in the urban environment. I argue that Ammanis are playing an active role alongside government and foreign agencies in creating a unique city identity. The study provides a micro, rather than macro, analysis of urban development in this Jordanian setting.
Perfluorocarbon (PFC), owing to its oxygen-carrying potential, has been excessively studied as a blood-substituent. This ability makes PFC micelle a suitable candidate for reporter system of tumor hypoxia imaging, exploiting the unmet need of oxygen in hypoxic tissue. We present a noble near-IR dye labeled PFC micelle whose stability of oxygen transport is directly linked to fluorescence quenching. In the vicinity of trapped oxygen, the near-IR fluorescence from the micelle was quenched. When oxygen was released at the low oxygen tension region of hypoxia, de-quenching was observed, leading to high fluorescence emission.
Pd coupling reactions are among the most widely used chemical transformations in the synthesis of pharmaceuticals and bioactive compounds. Development of novel Pd catalysts can lead to new and more economical methodologies for obtaining a wide range of complex organic molecules with biomedical applications. We recently reported unprecedented mononuclear organometallic PdIII complexes with a tetradeutate ligand $N,N'$-di-tert-butyl-2,11-diaza[3,3](2,6)pyridinophane ($t$BuN4). With a smaller N-substituent, MeN4 was found to support high-valent PdIII and PdIV complexes that have recently been proposed as important intermediates for a variety of Pd-mediated catalytic reactions. A further modified version of the MeN4 ligand has been synthesized by attaching a methoxy group at the 4-carbon positions of the two pyridine ring regions. PdIII complexes were prepared with this new ligand (MeN4OMe) in order to investigate electronic effects on similar PdIII complexes.
Opsins, light-sensitive membrane-bound G-protein coupled receptors, can be selectively and asymmetrically activated in a cell. Those opsins exhibiting a broader peak of absorbance cannot efficiently be discretely activated in a cell because the broad range of peak absorbance often includes the wavelength of the fluorescent protein. Thus the opsin cannot be activated without activating the fluorescent protein as well, and live imaging requires that fluorescence be visible throughout the entire course of affecting cellular processes. In order to create spectrally selective optical instruments to be used in further studying and controlling cellular signaling pathways, point mutations are introduced into native opsins, specifically red opsin. Cells expressing the opsin undergo live imaging. The imaging process demonstrates that mutations are a legitimate method of introducing and enhancing spectral selectivity in the proteins. The opsins created will be used in the novel unobtrusive method of observing cellular signaling pathways and directing cellular response.
Seasonal Timing and Intensity of Fire Alters the Competitive Relationship Between the Invasive Legume, *Lespedeza cuneata*, and Co-occurring Native Species

Eleanor Pearson

Mentor: Raelene Crandall

Land managers often use prescribed fires for restoration in habitats that have co-dominant native and invasive plants, despite lacking knowledge of the appropriate season for burning. Plants often have divergent responses to fires in different seasons. Therefore, it is important to burn during a season that will decrease abundances of invasive plants while simultaneously increasing abundances of native plants, such as dominant perennial grasses known to stabilize ecosystems. The fire season that is best for controlling invasive populations may also be the one that is most detrimental to native plants, so the entire system should be evaluated before prescribing fire. The objective of this study was to examine the effects of prescribed fires during different seasons on survival of an invasive legume, *Lespedeza cuneata*, and native perennial grasses, *Schizachyrium scoparium* and *Androgogon gerardii*, and diversity of the native plant community. In old-fields near Saint Louis, Missouri, invaded plots were unburned or burned during different stages of *L. cuneata*’s development: spring seedling recruitment/early growing season (May), low carbohydrate reserves (mid-July), fall reproduction (October), or dormant period (January). We found survival of both *L. cuneata* and perennial grasses was significantly lower during July as compared to all other burn seasons. Species diversity was significantly higher in burned plots regardless of season, as compared to the unburned controls. Burning in July is the most effective time for managing *L. cuneata*, but is also the most detrimental to survival of perennial grasses. It is important to evaluate the effects of fires during different months on both invasive and native plants during different life stages as well as on communities of native plants prior to using prescribed fires to restore degraded habitats.
Alzheimer’s disease (AD) is the most common cause of age-related senile dementia, and there is no treatment to date. Large amounts of Amyloid-β (Aβ) fibrils are found in AD patients, although recent research has suggested that the soluble Aβ oligomers are more neurotoxic than Aβ fibrils. Aβ aggregation is modulated by the interactions with metal ions, Cu and Zn, in brain cells. This interaction between metal ions and Aβ offers novel therapeutic targets to inhibit the progression of AD. Bifunctional compounds (BFCs) offer such a target by binding to the Aβ and chelating to the metal ions. Our BFCs are designed based on thioflavin-T (ThT) structural framework for Aβ binding and metal binding groups are either incorporated (BFCs L1, L2) or linked to a strong metal chelator to ThT framework (BFCs L3, L4). The interactions between BFCs, Aβ, and metal ions were monitored by the use of native gel electrophoresis/western blotting, transmission electron microscopy (TEM), and ThT fluorescence. L1 and L2 showed no significant oligomerization with disaggregation and inhibition experiments. L3 and L4 were found to effectively inhibit the aggregation of Aβ and promoted the disaggregation of Aβ fibrils without much oligomerization. Cell toxicity studies for these compounds are currently being conducted. These BFCs show promise in inhibiting and disaggregating the Aβ fibrils and are encouraging us to use these compounds for future in vivo studies.
The black holes at the centers of some galaxies serve as the sites of the strangest physics known today from plasma physics to general relativity, high energy particles to thermodynamics. A small subset of these galactic centers, known as Active Galactic Nuclei (AGN), show a remarkable amount of full-spectrum activity over very short astronomical time scales. In this project, the Antipodal Transient Observatory (ATO) is used to make continued optical observations of Markarian 421, Markarian 501, and W Comae; three such AGN. These observations, in conjunction with observations made by the Very Energetic Radiation Imaging Telescope Array System (VERITAS), the Fermi Large Area Telescope (LAT), the Swift Ultra Violet and Optical Telescope (UVOT), and the Swift Burst Alert Telescope (BAT) permit the creation and analysis of multi-wavelength light curves as well as full spectrum analysis. The light curves produced by the multiple sets of observations between February and June 2012 show some correlations, though are low in variability. Due to the approximation methods required to produce the spectra of these two sources, only a qualitative confirmation of previous models of radiation mechanisms can be given. However, an anomaly in the X-ray range of W Comae brings into question the accuracy of the SSC model for W Comae. This work also emphasizes the basic research methods of astronomy including image reduction aperture photometry, and a background of the interplay between astronomy and radiation theory.
In the early 21st century, culture-led urban regeneration became all the rage in American and European planning circles. However, the idea is not new. Leopold Sedar Senghor was Senegal’s first president following the West African country’s independence from France in 1960. A poet-philosopher and key theorist of negritude, Senghor believed that by first developing national identity through the arts, national prosperity would follow. He promoted “High Art” while censoring popular, “low brow” cultural forms. While he succeeded in turning the country (specifically the capital city, Dakar) into an international cultural hub, he neglected to stabilize the economy. Thus, subsequent leaders focused less on cultural policy and more on economic development. This meant less funding for the arts, but also allowed previously banned art forms to emerge.

This project examines cultural policy and production in Senegal since Senghor, focusing on two of Dakar’s emergent cultural scenes: “feminist” art and theatre for development. The first case examines how eight women-artists expand and break out of the limited notions of gender previously offered by negritude; appropriate and critique “Western” notions of womanhood/feminism(s); and use local cultural forms and communitarian values in crafting their work. Secondly, I analyze how the Kaddu Yarakh troupe creates participatory, issues-based plays using multiple sources: the methods of Augusto Boal’s “Theatre of the Oppressed;” NGOs; and the conflicts and desires found in their community. These artists’ comfort with integrating local, global, and transnational influences speaks to Dakar’s tradition of créolité, holding “African/Western,” “indigenous/colonial” in creative tension.

These analyses speak to a broader question: How does one evaluate the effects cultural policy and production on economic development, and vice versa? By looking at how such practices have been implemented in Dakar since 1960, I hope to provide some evidence-based insights for cities considering similar strategies today.
Toward a Better Understanding of...

**Effect of Blocking GABA-A Receptors on the Response of Cerebellar Ventral Paraflocculus Purkinje Cells**

*Lynn Ren*

*Mentor: Pablo Blazquez*

The cerebellar cortex plays an essential role in fine motor control, yet we know remarkably little about the computations it performs. Cerebellar cortex anatomy consists of three layers: the input or granular layer, the output or Purkinje cell layer, and the outermost or molecular layer. Between the input and output layer, information reaches local circuit neurons that perform signal transformations not yet well understood. In this study, we use the oculomotor system of the macaque monkey as our model system for studying these signal transformations. Our preliminary data suggested that inhibition shapes the directional preference of Purkinje cells during saccade eye movements. To further test this hypothesis, we used gabazine (a GABA-A antagonist) to block inhibition while simultaneously recording from VPFL Purkinje cells in the macaque monkey (while performing oculomotor tasks) using multi-barreled electrodes. Our goal was to infer the role of inhibitory interneurons in shaping the output response by comparing VPFL Purkinje cell responses before, during, and after gabazine injections. We found four classes of Purkinje cell responses to visually guided saccades before drug application: i) Neurons that respond with an increase in firing rate during saccades in any direction; ii) Neurons that respond with a decrease in firing rate during saccades in any direction; iii) Neurons that responded with an increase in firing rate during saccades in a given direction and with a decrease in spikes in the opposite direction; iv) Neurons that do not change their firing rate during saccades. After drug application (gabazine), most Purkinje cells responded with an increase in firing rate during saccades regardless of the saccade direction. These results agree with those obtained from preliminary data, suggesting that inhibitory interneurons play a role in shaping Purkinje cell directional preferences during visually guided saccades.
Heterozygosity for the Tumor Suppressor Gene NF1 Confers a Differential Sensitivity to Ionizing Radiation In Vivo

Madelyn Reynolds

Mentor: David H. Gutmann

Neurofibromatosis 1 (NF1) is a common inherited tumor predisposition syndrome characterized by the development of low-grade brain tumors, or optic pathway gliomas (OPGs), in children. Although radiation therapy is a common treatment modality in children with sporadic OPG, it is not recommended for NF1 patients, given their increased relative risk for radiation-induced secondary malignancy and cognitive decline. Previous work in our laboratory has demonstrated that microglia, macrophage-like cells within the central nervous system, are increased in NF1-associated OPGs, and that ablation of Nf1+/- microglia attenuates glioma proliferation in a preclinical mouse model of OPG. Moreover, others have shown ionizing radiation activates microglia in vivo, which contributes to impaired neurogenesis in the hippocampus of irradiated animals. Thus, we sought to further delineate the role of Nf1+/- microglia in the response to radiation. Wild type and Nf1+/- mice were treated with 10 Gy of cranial irradiation, and euthanized at various time points after treatment. Immunohistochemistry and immunofluorescence were used to quantitate the total number of microglia and Sox2 + neural stem cells (NSCs). We found that there was a significant decrease in Iba1-positive microglia as a percentage of total cells in the hippocampi of Nf1+/-, but not wild type, mouse brains after radiation. Moreover, this decline coincided with reduced proliferation of Nf1+/- Sox2 + NSCs in vivo. Our results demonstrate that Nf1+/- NSCs and microglia in mice are more sensitive to ionizing radiation, which may underlie the increased propensity for late cognitive side effects. Future studies will address whether radiation-induced activation of microglia is necessary for the impaired proliferation of Nf1+/- SCs or if the effect is cell-autonomous.
A Tactile Perception System for Sensing the Visual World

Colleen Rhoades

Mentor: Etienne Cummings, Johns Hopkins University

A device was designed and prototyped that allows users to identify different colored objects by using the sense of touch rather than vision. Optical sensors located in the fingertips of a glove send information about the red, green, and blue components of the contacted object to a computer which categorizes the color into one of 48 bins based on the hue and saturation levels. That information is translated to a vibrotactile vest which consists of 48 tactors, each a separate point of vibration on the user’s torso. Each tactor vibrates in response to a particular color. This sensory substitution allows users to “feel” color through the pattern of activation of the motors. An application of this device is to allow individuals who are visually impaired to identify objects in the physical world through touch.
Ground-based gamma-ray telescope arrays can be used to view Cherenkov light created when a high-energy photon interacts with a massive particle in the atmosphere, creating a cascade of photons and particles of very high energy called an electromagnetic shower. The sources of these gamma-rays are not thermal sources (e.g. stars), but energetic non-thermal sources (supernovae, black holes) capable of accelerating particles up to very high energies. The spectrum, angular distribution, and time variability of the VHE gamma-rays from these sources can be used to infer information about what created them, giving astrophysicists useful information about some of the most extreme events in the universe. This project aims to exploit the characteristics of the next-generation atmospheric Cherenkov telescope arrays to improve angular reconstruction of the gamma-rays near the instruments’ threshold energy. The idea is to supplement the standard analysis with information of the relative arrival time of the Cherenkov photon wavefront. This might be accomplished by adding hardware to implement a more accurate timing system among the telescopes relative to one another. Various methods for timing synchronization were considered and the White Rabbit project looked promising. In addition to identifying the timing limitations of such hardware approaches, algorithms to combine time measurements from an array of telescopes to reconstruct both the shower direction and mean height of shower development in the atmosphere are being developed and tested on Monte Carlo simulations of photon arrival times for simulated events. Since the computations need to be completed at a high rate, algorithms that use the discrete spacing of telescopes to pre-compute costly aspects of the analysis are explored. Algorithms for this do exist but with the advent of more detailed simulations and larger telescope arrays, there is potential for improvement.
This research intends to illuminate the interdependent relationship between literature and neuroscience. In the study of English literature, we use words to illuminate the greater text. A word is charged with the weight of its history; a single use of a word absorbs past meanings that it derives from etymology, context, and past uses. Now we have this external code that we use to understand language, and through this, enhance our understanding of literature. The questions that arise from this are: “Do we have an internal understanding and transcending experience at the moment of reading? Can the history of a word influence our internal perception of the word, distinct from our conscious processing of the meaning of the word?” In sum, how are we affected cognitively by authorial word choice?

I aim to prove that there is a network of associations that we perceive and make use of in the reading of a single word in literature. This study will discern whether multiple meanings in a semantic web are activated upon reading a line and literature, and test whether that activation will remain after successive lines are added to the initial line. Current literature on memory and semantics finds that semantic associations are activated for only milliseconds; however, I believe that our mind is able to comprehend and store these associations for a longer period, in order that we may make use of these associations in the process of literary reading.
The Degenerin/Epithelial sodium channel (DEG/ENaC) family is comprised of amiloride-sensitive, non voltage-gated sodium channels. These channels have two transmembrane regions, N and C intracellular termini, and an extracellular loop. For the most part, the functions of these channels remain unknown. The *Drosophila* genome encodes 31 DEG/ENaC subunits called *pickpocket (ppk)* genes. We previously found that a member of the (DEG/ENaC), the chemosensory specific channel *pickpocket 23 (ppk23)* plays a significant role in normal *Drosophila* male courtship behavior. Thus, I tested hypothesis that multiple DEG/ENaC subunits are playing a chemosensory role in courtship behavior.

I performed an *in vivo* RNAi screen of the 31 *ppk* genes identified in the fly genome. In other words, RNAi was driven transgenically in the nervous system of *Drosophila*. Individual F1 virgin males from each cross were video recorded while mating with wild type female virgins as the target. Two parameters, courtship duration and latency, were measured from these videos. Courtship duration is the time period that the males begin and continue court the females, while latency is the time measurement prior to courtship.

Our data suggest that at least some *ppk* genes knockdowns seem to show a significant influence on male courtship behavior, one specifically being the *rpk* gene. We found that the courtship index had a value of zero more than 50% of the time. This is very low compared to our control, thus indicating some significant influence on behavior. For future studies, we will repeat the analyses of positive genes from the RNAi screen with classic mutant alleles. With these data, we might discover courtship related roles for additional DEG/ENaC subunits, expanding our knowledge about an important but poorly understood family of ion channels.
Understanding the growth cycles and metabolisms of photosynthetic bacteria are important for finding new applications and unlocking more biological information about these types of bacteria. In order to understand the growth of a bacterium, its biomass must be tracked. Biomass is accumulated by the growth of bacteria in a specific medium and its subsequent cultivation. Producing biomass is essential to analyzing and quickly producing specimens to experiment upon. To understand how to cultivate biomass at a faster rate, various growth media were compared to see in which sample bacteria grew the fastest. The bacterium *Chlorella* was used for this comparison and to see how different mixtures and solutions affected the growth rates of *Chlorella*. The most biomass was cultivated in a medium called Chlorella Medium, however when the primary component of this medium (Urea) was added to another medium known as BG -11, the result was a slower and more broad growth curve. Another valuable tool in understanding more about photosynthetic bacteria is learning about their metabolic cycles. Through experimentation with Carbon-13 labeled glucose and the use of GCMS (Gas Chromatography Mass Spectrophotometer), theories about the metabolism of a bacterium can be formed based on experimental data. Chloroflexus, a thermophile, was analyzed in this manner along with other bacteria to prove the validity of this experiment and to open up new experiments. Currently the experimental method is being used on many bacterial samples with final results to be determined.
Toward a Better Understanding of...

Understanding the Properties of Cornstarch in Oil Suspensions

Hannah Sieber

Mentor: Jonathan Katz

Despite how common suspensions of cornstarch in water are, the science behind the shear-thickening that children find so fascinating is not completely understood. This “oobleck” suspension is being studied by many, but the goal of these experiments has been to study various other suspensions with the hopes that understanding them will give us insight into the seemingly magical qualities of cornstarch in water or brine. Data was collected on suspensions of cornstarch in oil at various concentrations using an AR-G2 Rheometer. Each sample experienced two runs on the rheometer, one that tested the suspension at increasing strain rates (from 0.0316 to 316 rotations per second), and the other running decreasing strain rates (from 316 to 0.0316 rotations per second). Data was found to be reproducible between the range of 30% cornstarch in oil (by mass) to 55% cornstarch in oil (by mass). The data from these samples shows that cornstarch in oil does not exhibit shear-thickening. It is clear that some property is critical that differs between water and oil. Using a disk of delrin plastic, we hope to constrain these suspensions to see if the differences in surface tension could be the cause of this lack of shear-thickening. By constraining the suspension we hope to reproduce this stronger surface tension.
Toward a Better Understanding of...

SHACKLED BY SOCIETY:
SLAVERY, HIP HOP, AND THE CULTURAL POLITICS OF MEMORY

Dylan Simonsen

Mentor: Sowande’ Mustakeem

This research project conducts a socio-cultural analysis of contemporary hip hop to reveal the implications it has in forging a shared memory of American slavery in the 21st century. Due to its widespread influence, hip hop has served as an ideal medium for circulating discussion surrounding the evolution and historical origination of the African-American identity. The individual work of late 20th century and early 21st century artists has given rise to several historically significant lyrical and visual pieces. This project not only compares the fundamental elements of the hip hop music industry to the archetypical construct of antebellum slavery, but it also follows the chronological development of hip hop’s commemoration of plantation bondage by examining the work of individual artists via their lyrical, rhythmic, and visual production over the past 25 years. The research draws upon mostly primary sources including song lyrics and music videos and compiles them in a database. In conjunction with secondary source documentation, this database expounds that hip hop artists have used their music as a vehicle for stimulating conversation surrounding the history of black captivity and its pertinence to modern-day culture. In a broader sense, this important research study provides first of a kind scholarship on the role of contemporary music in the production of history and memory.
The brain has an enormous capacity for processing and interpreting data from the outside world, reflected in complex neural activity that bridges brain areas. It has been shown in vivo that artificial electrical stimulation can alter neural activity; in particular, stimulation of one cortical area based on activity in another area can train two areas to respond more similarly after presentation of a stimulus. To understand the effects of such stimulation in the brain, we modeled neural networks with variable numbers of parallel feed-forward pathways in the presence of uncorrelated or moderately correlated background activity. We stimulated each network by recording the firing of action potentials from one neuron and stimulating another neuron at a fixed delay with respect to firing (so-called spike-triggered stimulation, or STS). We found that STS performed predictably when the pair of selected neurons had a monosynaptic connection. In the presence of uncorrelated background activity, STS between two disynaptically connected neurons (i.e., connected through an intermediate neuron) achieved some correlation between the targeted neurons at the expense of coupling within the target pathway and auxiliary pathways as well. In the presence of correlated activity, STS achieved correlation between the targeted neurons while preserving, and even strengthening, endogenous coupling within target and auxiliary pathways. We found that we could obtain similar effects with STS by increasing the number of pathways between disynaptically connected neurons. These results suggest that neural network manipulation is most effective within pathways driven by background correlation or induced by the network’s structure. These results provide evidence that correlated input distributed throughout a neural pathway may provide a major role in modulating the joint activity of neurons that are not directly connected.
G-protein coupled receptors (GPCRs) are a major class of transmembrane receptors found to mediate the transduction of a light signal from the retina to the brain in vision. The rod photoreceptors synapse onto the rod bipolar cells (BPCs). The activity of depolarizing, or ON BPCs, is mediated by a GPCR known as metabotropic Glutamate Receptor 6, or mGluR6 and the Gαo subunit. The signaling of the Gαo subunit is regulated by Regulator of G-protein Signaling molecules (RGS), the RGS7 family being specifically associated with mGluR6. RGS regulation has been shown to be necessary for normal synapse formation; the absence of RGS7 regulation results in an abnormally delayed signaling response, as well as abnormal synapse formation.

To examine this signaling pathway, we used two models of RGS-insensitive mice for Gαo and Gαi2 proteins which result in augmented (uninhibited) signaling. While Gαo is known to play a role in rod-ON BPC signaling, it is unknown what role the Gi2 subtype plays in the retina. We performed electoretinogram recordings and discovered a normal ERG for Gαo with unexpected hyperpolarization at the tail end of the recording. Synaptic morphology was normal, demonstrating that RGS regulation of Gαo signaling is not required for synaptic formation. Gαi2 mice displayed a diminished ERG A-wave amplitude, implicating a previously unknown role in the light-transduction mechanism of rod photoreceptors. G-protein signaling in the eye provides an excellent model for understanding the role of GPCRs in vision, and the regulation of cellular signaling in the retina.
Toward a Better Understanding of

The Effects of Glade Area and Presence of Fire on Plant Diversity in the Ozark Mountain Glades of Southern Missouri

Amelia Snyder

Mentor: Tiffany Knight

In order to determine the effects of varying area, perimeter length, and the presence or absence of fire on glades in the Missouri Ozark Mountains, we sampled fourteen glades over twelve days in early June of 2012. Glades are fragmented desert ecosystems that historically burned at least once a decade. They have thinner soils and higher median temperatures than the surrounding forest. At each glade we recorded the name and quantity of flowering species present along each of our five two-meter wide transects. We used these to determine diversity. We then recorded the flowers present in the entire glade and used this data for glade species richness. Finally we walked around the glade perimeter with Garmin Rino 650 GPS units to record glade area and perimeter. We used a One-Way Analysis of Variance to determine statistical significance and found that burning glades increased both the diversity ($p = 0.00765$) and species richness ($p = 0.01057$) of the flowering plants present, while varying the area and perimeter of glades showed no significant effect on either diversity or richness. These results show that land managers interested in preserving diversity should burn all glades, even small glades. This work also demonstrates the necessity of reexamining the United States’ governmental fire suppression policies, particularly in ecosystems that were historically fire dominated.
This study examines recovery in the domains of cognitive abilities, communication, physical function, and participation in daily life in participants at 6 and 12 months post-stroke. Based on current literature, we hypothesized that participants will experience improvement between 6 and 12 months in cognition, communication and participation in daily life, but will not experience changes in physical function. Data were collected on participants admitted to The Rehabilitation Institute of St. Louis from 2010-2012. All participants had a primary diagnosis of stroke. To assess recovery, participants were contacted by email, phone, or mail at 6 and 12 months post-stroke. Participants completed a survey that included the Stroke Impact Scale (SIS), Modified Rankin Scale (MRS), Reintegration to Normal Living Index (RNL Index), Functional Ambulation Category (FAC), and questions about return to work and driving. The SIS domains included physical function, cognition, communication, and participation in daily activities/quality of life. Paired sample t-tests were used to assess change in impairment level between 6 and 12 months for all variables. 102 participants were analyzed in the final sample size. The average age at stroke onset was 61 years of age with the majority of the sample (51%) self-identified as African American. The paired sample t-tests showed no statistically significant difference between time points for any assessments: SIS physical function (p = 0.75), SIS cognition (p = 0.81), SIS communication (p = 0.59), SIS participation (p = 0.27), MRS (p = 0.78), FAC (p = 0.33), RNL Index (p = 0.16), return to driving (p = 0.20), return to work (p = 0.52). There is no significant change in functional status as measured by lack of gains in cognition, communication, physical function, and participation in daily activities between 6 and 12 months post-stroke.
Authority and Autonomy: How Technocratic Rituals Surrounding Childbirth Redistribute Power and Hurt Birthing Women

Joan Steffen

Mentor: Carolyn Sargent

Despite the wealth of data demonstrating the harm in applying medical procedures intended for high-risk deliveries and obstetric emergencies to low-risk births, rates of medical intervention during childbirth remain high in the United States. Rituals heavily based on technocratic belief systems permeate the birthing process and obstetric training, thereby constructing the cultural authority of biomedicine. This authority reinforces elements of the obstetrician-patient relationship which place birthing women in a submissive, disempowered position with regards to their own births and promotes unnecessary and often harmful medical intervention in birth. More study should be dedicated to the training of obstetricians, since this process appears to play a role in elevating medical interventions above other ways of handling birth. Research on medical training can also identify ways to transform the culture of obstetrics and create space for a more balanced, pluralistic system. At the same time, work to study, protect, and promote alternative paradigms for understanding and handling birth can preserve the spectrum of options available to women. Hopefully, research of the systems which create the current biomedical hegemony can provide the knowledge for successful activist efforts in broadening birth options and empowering birthing women.
Recent research has shown that rapid speciation of weakly electric mormyrid fish occurred alongside the evolution of a more complex electric signal in the mormyrid subfamily Mormyrinae, as compared to the other mormyrid subfamily, Petrocephalinae. This raises the question of whether other sensory systems are more important for communication in Petrocephalinae. The hypothesis for this study is that Petrocephalinae rely more on vision for communication than Mormyrinae do.

Previously, it has been discovered that Petrocephalinae species generally have relatively larger eyes and optic tecta, a major brain region for visual processing, than do Mormyrinae, thereby supporting the hypothesis from an anatomical perspective. The optomotor reflex response of various species was used to determine whether these anatomical differences are related to differences in visual acuity. This experiment uses a striped drum that rotates around a circular fish tank. Theoretically, if a fish can see the moving stripes, it will swim in the same direction as the stripes, demonstrating a classic optomotor response. By testing a variety of stripe widths for each fish, one can obtain a threshold stripe width that elicits a response, thereby giving a measure of visual acuity.

Upon testing mormyrids, I have found that most species respond to visible spinning stripes by swimming significantly more in general, rather than by swimming only in the same direction as the stripes. By measuring the response to eight stripe widths for nine species it was discovered that Petrocephalinae do indeed react to smaller stripe widths than do Mormyrinae, indicating that Petrocephalinae have sharper visual acuity. Both anatomical and behavioral tests thereby support the hypothesis that Petrocephalinae rely more on vision than do Mormyrinae.
Toward a Better Understanding of…

Discourses of “Development” in Brazil: Perspectives on the “New” Middle Class, Social Inequality, and the Emphasis on Consumerism

Celina Stein-della Croce

Mentor: Bret Gustafson

In Brazil, the discourse of the current administration, the Partido dos Trabalhadores has focused largely on the eradication of poverty and what is referred to as the rise of the new middle class. The discourse has become prominent not only within the government but also in academia, everyday life, and popular culture. According to the federal Secretary of Strategic Affairs, the “new” middle class refers to families that earn a total monthly income of between U.S. $524 and U.S. $2,248 a month. The inclusiveness of this category and the focus on consumer goods and material wealth in the new middle class discourse distract from larger structural issues that newly deemed members of the middle class face on a daily basis, such as a lack of access to adequate health care, transportation, and secure housing.

This focus also emphasizes capitalism and materialism as a solution to achieving “modernity” and “development” while delegitimizing other ways of life and perspectives that are not based on market economies and capitalism. The key questions that I seek to answer are: What do we mean by “development?” What is Brazil developing towards? Why has the “new” middle class been produced as a development discourse in Brazil? How has this discourse developed, what does it exclude, and what role does it play in the positioning of Brazil as an international figure? Based on ethnographic research I conducted in Brazil, I argue that the production of the new middle class discourse distracts from underlying structural problems and projects Brazil as a “developed” nation with a ‘modern’ populace and high consumer power in order to position the country as an important international player.
Radiative Cooling for the X-Calibur Polarimeter

Marybeth Stork

Mentor: Henric Krawczynski

X-Calibur is a balloon borne experiment which will measure the polarization of X-rays emitted by black holes. The purpose of this research was to aid in the development of a radiative cooling mechanism to prevent overheating of X-Calibur during daytime hours. The design included fluid circulation and ventilation which would carry excess heat to two radiator plates located on the outside of the vessel containing the polarimeter. Research consisted of three main components. In the first component, we tested various materials for thermal properties relying upon wavelength dependent emission and absorption properties. We subjected an unpainted aluminum plate in a vacuum chamber to heat injection and sunlight and measured its temperature over time. We then repeated the experiment with an aluminum plate covered with aluminized mylar, and again with a plate painted with an epoxy. The tested epoxy outperformed the aluminized mylar in these experiments. In the second component, we tested the efficiency of cooling through fluid circulation and ventilation in an enclosed volume. We placed a fan inside an aluminum cylinder, and ran tubes from a water pump through the cylinder. We injected heat into the cylinder and measured its temperature several times, first with the fan and water pump switched off, then only the pump on, and finally both switched on. Results indicated that both fluid circulation and ventilation are effective cooling mechanisms. The final component consisted of running simulations to predict the design effectiveness. Simulations indicate that the radiative cooling mechanism provides limited cooling in flight conditions; nonetheless, the simulations also indicate that X-Calibur will not overheat provided adequate thermal insulation.
The Suprachiasmatic Nucleus (SCN) is situated directly above the optic chiasm and is a circadian pacemaker that regulates daily physiology and behavior, such as sleep and wake, physical activity, hormone levels, and body temperature. However, it is not known which cellular and molecular processes and connections generate and regulate circadian rhythms during the development of the SCN. Since the peak of neurogenesis occurs prior to birth, we hypothesize that by day 16 of gestation, neurons in the SCN are rhythmic. Furthermore, because neurogenesis in the SCN is complete prior to birth, we hypothesize that neurons in the SCN are rhythmic and synchronized in postnatal mice. In mammals, the *Period 1 and 2* genes are essential in sustaining cellular circadian rhythms. We used PER2::LUCIFERASE knock-in mice to record bioluminescence as a reporter of PER2 protein levels from cells in bilateral SCN explants, using both photomultiplier tubes and cameras. We found that the neurons in the SCN were synchronized to each other in the postnatal day 1 (P1) SCN with a period of \(~23.03\) hours (n= 10; mean +/- 0.68). We found similar results in the P3 SCN (n=1). Thus we can conclude that by postnatal day 1, SCN cells are circadian and synchronized to each other indicating that cell-cell communication had developed.
Women's beliefs about, knowledge of and access to family planning are influenced by many factors—external, cultural and personal—and must be understood in their context. Refugees often are in an especially vulnerable position in terms of access to family planning. Nepali Bhutanese refugees in America are and have been in a vulnerable position in terms of resources and access to health care, and have experienced the influences and environments of several cultures in succession. In this research, I interviewed five Nepali Bhutanese refugee women in St. Louis on factors influencing their views and choices about family planning and their perceived access to it. Nepali Bhutanese refugees who are newly arrived have more limited knowledge about family planning and how to obtain it in their new environment, and express more negative views towards it. Women who have been in America longer, however, have more positive views towards family planning and have clearer information on how to obtain it if needed.
In 2010, the Government of Senegal developed the Programme Nationale d’Investissement Agricole with the goal of acquiring the necessary investment to achieve “food sovereignty” by 2015. Currently, the country has become dependent on international trade and the importation of cereal grains, with rice accounting for more than half of all food imports. This form of governmentally driven development represents a pioneering effort for increased food production in Africa. With foreign investment to accomplish the desired results, Senegal works with other international actors to address the problems of food production in the status quo. However, in an effort to solve the barriers to food sovereignty, Senegal faces other external and internal challenges that it must overcome. Market values, production levels, and rainfall all impact the ability of the country to reach food sovereignty. By interviewing development officials, analyzing production levels, and evaluating environmental reports, this research examines the question of whether Senegal will be able to achieve its goal by the desired date. Although the programs have led to advances in technology and increased agricultural production, environmental and social factors limit the ability of the programs to succeed.
Toward a Better Understanding of...

Observing the Effectiveness of a Mobile Research Van in Recruiting Representative Populations of African Americans in a Health Care Study

Kawana Tharps

Mentor: Mary Politi

Research has shown that individuals from minority groups, including African Americans, are often underrepresented in health care studies. Barriers to recruiting ethnic and racial minorities into health studies include mistrust of medical research, lack of awareness about available studies, and failure to meet eligibility criteria. In order to gain representative population of minorities into health studies, more effective methods of minority recruitment have to be implemented. Without improving minorities’ participation into research, health disparities can continue, as new medical therapies and behavioral interventions might not apply to populations excluded from research studies. The goal of this study was to examine the efficacy of the Neighborhood Voice van, a mobile recruitment van, at enrolling minority participants (specifically Blacks or African Americans) into a health related study. This study was part of the first aim of a larger study investigating Missouri’s uninsured population’s understanding of health insurance terms.

Fifty-one of the 65 individuals who were eligible to participate in the larger study agreed to participate; 68.63% of participants were African American. By county, African American participation was detailed as follows: 1 of 14 participants (7.14%) in Jefferson County, 12 of 14 participants in St. Louis County (85.71%) and 22 of 23 participants (95.65%) in St. Louis City. Overall, this study provided support for the hypothesis that the mobile van can be an effective recruitment strategy for reaching minority participants, especially African Americans, since the population of African Americans in Jefferson County, St. Louis County and St. Louis City is 1.0%, 23.4%, 48.3%, respectively. However, given the relatively small sample size (n = 51), these findings should be replicated before concluding that the Neighborhood Voice is truly effective in recruiting a representative percentage of African Americans proportionate to the overall population into health related studies.
All animals have mechanisms to sense and regulate pain. Typically, aversive stimuli are sensed by specialized sensory cells, which then communicate this information to the brain. The sensation of pain is highly variable and similar stimuli might induce different behavioral responses under different environmental and behavioral conditions. However, little is known about how pain plasticity is modulated. In recent years, *Drosophila melanogaster* has emerged as a good model to understand the molecular and cellular basis for pain at the sensory level. However, the roles of central modulatory pathways have not been investigated. We hypothesized that FMRF, a neuropeptide, and its receptor, FR, play a key role in this pain modulation by making an animal hyposensitive to an aversive stimulus. My initial data suggest that FMRF and FR do play a role in central pain modulation in *Drosophila*; null mutations in both the neuropeptide and its receptor resulted in hyposensitivity to pain, suggesting that this neuropeptidergic signaling pathway is involved in regulating the pain threshold. These findings are significant because they could lead to a better understanding of pain central modulatory pathways in all animals; not only would this lead to a better general understanding of these pathways, but it could eventually lead to finding better treatments and ways to more effectively manage pain.
This project examines the effect of anonymity on online discourse, specifically regarding political polarization. I contend that the anonymous nature of online discourse divides the online public. Current scholarship on the internet’s effect on deliberation is divided, but it often ignores or fails to examine in depth the anonymous or pseudonymous nature of most online discourse. I agree with scholars who argue that the current state of the internet promotes the formation of strong group identities. This project uses the psychological model the social identity model of deindividuation effects to further claim that when online discussion occurs anonymously, these group identities lead to increased political polarization.
Toward a Better Understanding of...

Oh the Irony! Protective Effect of Parity and Lactation on Anemia in Mothers, not Infants

Rubabin Tooba and Jessica Yoon

Mentor: Elizabeth Quinn

Previously, research on the relationship between maternal hemoglobin and anemia during lactation has reported increased risk of anemia among women at higher parities-particularly in women with marginal nutritional statuses. However, the majority of these studies investigate populations of variable maternal age and parity, making it difficult to separate the associations of age and parity with iron status. Here, we investigate the association between parity and hemoglobin levels during lactation.

Reproductive histories were collected from 125 lactating women (ranging in parity from 1-5) from Cebu, Philippines, at two year intervals. This allowed us to facilitate reconstruction of investment in lactation, pregnancy, and non-lactating, non-pregnant time intervals. Hemoglobin level was also measured in the same 2-year intervals via fingerpricks on a Hemocue B-Hemoglobin analyzer. All analyses were run in Stata 10.1.

Maternal parity was a significant predictor of hemoglobin levels during lactation. First time mothers were significantly more likely to be anemic during lactation than mothers of higher parities. Mothers on their second parity had the highest mean hemoglobin values with a modest decline in hemoglobin with later parities. These associations persisted even after adjustment for other potential maternal factors, such as iron supplementation during pregnancy or dietary iron intake. There was a modest decline in hemoglobin status among mothers with parities greater than 4. Among multiparous women, there was no significant association between hemoglobin and prior breastfeeding lengths or interbirth intervals, suggesting that the iron requirements of pregnancy and lactation are successfully managed by this population.

First time mothers are at significantly higher risk to be anemic than multiparous mothers. Dietary practices, longer lactations, and extended interbirth intervals may help mothers recover and maintain iron stores over multiple births.
Parkinson’s disease (PD) is a neurodegenerative disorder that is characterized by the death of dopaminergic cells in the midbrain. Although the etiology of PD is still unknown, numerous studies have suggested that at least later stages of the disorder are marked by autophagy, a process in which the cell gets rid of dysfunctional organelles. The O’Malley lab has shown that LC3 aggregates, a marker of autophagy, could be visualized in dopaminergic neurons at very early stages of cell death caused by the PD-mimetic, MPP+. To test the hypothesis that autophagy plays a neuroprotective role in PD, midbrain cells from mouse embryos were transfected with a fluorescently-tagged LC3, DsRed-LC3-GFP. The doubly-labeled probe allowed for the distinction to be made between autophagosomes and autolysosomes, which form at different stages of the autophagic process. The cells were then fixed at different time points (2 hr., 4 hr., and 6 hr.) in order to observe how the quantities of LC3 changed over 24 hours in response to MPP+. The cells were analyzed using light microscopy and cells exhibiting autophagic markers were quantified at each time point. Experiments analyzed to date indicate increasing quantities of cells expressing punctuated patterns of LC3 up through the 6-hr. time period. A significant increase in autophagic markers would ultimately indicate that autophagy is being upregulated during PD and therefore plays, at least initially, a neuroprotective role.
Zinc is an essential mineral for humans, so understanding zinc metabolism is relevant to human health. There is currently an incomplete knowledge of zinc transcriptional control. The Kornfeld lab used *C. elegans*, a nematode worm that has many conserved properties with mammals and responds transcriptionally to dietary zinc, to identify zinc-regulated genes. Four genes were identified that are induced by dietary zinc at the transcriptional level and contain a fifteen base pair element called the metal response element (MRE). When this element was removed, the zinc-inducible expression of one of these genes was reduced. Bioinformatic approaches were used to identify additional candidate genes in the *C. elegans* genome containing a MRE. Based on these observations, we proposed that genes containing the MRE are induced by dietary zinc and may play a role in zinc metabolism. The goal was to determine if candidate genes containing the predicted MRE are induced by dietary zinc. This can elucidate mechanisms of transcriptional regulation and identify genes that mediate zinc metabolism. I cultured worms in low and high-level zinc environments, extracted the worm RNA, and quantified transcript levels of candidate genes by qRT-PCR to determine if the gene was significantly induced. We can say with confidence that the F35E8.11 gene is induced by dietary zinc. F20C5.5, K01A12.4, and MO2D8.6 are likely induced. The RNA fold change for other genes tested did not significantly differ from basal levels to be determined as affected by zinc. Further experiments, such as using fluorescence microscopy to visualize transgenic worms with GFP or genetic analysis using loss of function mutations and RNA interference, are needed to confirm inducibility and the role of the MRE in zinc induction.
The RNA interference (RNAi) pathway uses small non-coding RNAs to target and degrade complementary messenger RNAs via an RNA-induced silencing complex (RISC), which contains an Argonaute family protein. Regulation of gene expression by RNAi is conserved across many organisms, including the trypanosomatid *Leishmania braziliensis*, a protozoan parasite that causes the disease Leishmaniasis in South America. Bioinformatics studies in *L. braziliensis* have identified two putative Argonaute family proteins: ARGONAUTE1 (AGO1) and PIWI. AGO1 has been demonstrated to participate in the 23nt siRNA-dependent RNAi pathway of *L. braziliensis*, but the precise function of PIWI and its importance in *L. braziliensis* RNAi remains unknown. Surprisingly, knockdown of PIWI in *L. braziliensis* reduced RNAi activity, which indicates that PIWI forms part of the RNAi pathway. In contrast, PIWI knockouts show little phenotype in African trypanosomes and those *Leishmania* species that lack RNAi pathways.

To fully characterize the role of PIWI in *L. braziliensis* RNAi, I am working to generate *piwi*-/- null mutants, and complemented lines bearing an epitope-tagged PIWI protein. RNAi activity assays and virulence tests in a *piwi*-/- null mutant will test the importance of PIWI in the RNAi pathway. Immunoprecipitation of the tagged PIWI and high-throughput sequencing of any co-precipitated small RNAs will be used to characterize the distribution of small RNAs bound to PIWI. In addition, sequencing of total small RNAs will be performed on the *piwi*- mutant. Epitope-tagged PIWI will also allow the identification of interacting protein partners, as well as immunofluorescence to determine the cellular localization of the PIWI protein. These studies may reveal novel classes of small RNAs and protein factors participating in *L. braziliensis* RNAi, and provide insights on the evolution of the RNAi pathway in other *Leishmania* species which retain PIWI but not ARGONAUTE.
The research conducted in the Efimov lab deals mostly with imaging of the cardiovascular region of the body. The purpose of these experiments is to test the effectiveness of certain cameras in observing the heart. These cameras are useful for a technique called optical mapping that helps track cardiac arrhythmias. optical mapping uses cameras to track fluorescent dyes that are injected into the heart. These dyes glow according to the voltage of the heart's surface; in short, these dyes are voltage sensitive. I wrote code using Labview to create data acquisition for the Rodgers Cardiac Sock. This sock is an elastic material lined with electrodes that fits around a heart. The gold squares on the elastic material are electrodes that record the voltage of the surface of the heart. This sock is useful because if there is an anomaly in electrical activity in the heart, the sock can be used to pinpoint the location of the problem by looking at which electrode recorded the faulty voltage.
Mutations of the cardiac transcription factor Nkx2-5 in humans cause congenital heart defects, a leading cause of death in infants. Heterozygous Nkx2-5 mice likewise develop heart defects, but the incidence varies with genetic background. My hypothesis was that these strain-specific differences arise from differences in gene expression in the different strains of mice we observe. The goal of my work was to find alleles linked to Nkx2-5 outside the 10 Mb region upstream of the Nkx2-5 locus on chromosome 17, as alleles in this region are linked to Nkx2-5.

To test this hypothesis, an RNA-Seq experiment was conducted in which RNA was isolated from hearts of 21-day old mice of a variety of genetic backgrounds. The RNA was sent to a core facility for sequencing, and the resulting data was analyzed using a statistical genomics package. Statistical tests such as two-way ANOVA and receiver-operator curves were performed on the known Nkx2-5 linked alleles on chromosome 17 to establish threshold criteria for true positive alleles. Based on these numbers, a list of 50 potential candidate alleles was generated. These alleles were validated using a mass-spectrometry method. Positive controls were the differentially expressed alleles in the 10 Mb region upstream of Nkx2-5 (true positives) and negative controls were equally expressed alleles outside this region (true negatives).

Results from this first set of alleles were inconclusive. Positive and negative controls behaved as expected, but the candidate SNPs were not consistent among the samples. Hearts will be isolated from more mice throughout the semester to assess other SNPs that may be potential candidates for the experiment.
Recent research into why vascular disease is worse in people with diabetes suggests that the phospholipase $A_2$ (PLA$_2$) family of enzymes may be involved. We hypothesized that the calcium-dependent PLA$_2$ alpha isoform (cPLA$_2$ $\alpha$), which catalyzes the liberation of arachidonic acid from fatty acid substituents leading to formation of vasoactive prostaglandins and leukotrienes, may be more important than calcium independent isoforms (iPLA$_2$) $\beta$ and $\gamma$ in the vascular response. To test this, we utilized a surgical technique that mimicked balloon angioplasty to damage the common carotid artery of cPLA$_2$ $\alpha$, iPLA$_2$ $\beta$ and iPLA$_2$ $\gamma$ KO and WT mice in order to compare the relative effects of each isoform on vascular remodeling and neointimal thickening of the vessel wall over 3 weeks. Serial cross-sections of the vessel were then analyzed to determine the intima to media (I/M) ratio as a measure of neointimal thickening. We expect to see the least neointimal thickening in the iPLA$_2$ $\beta$ and $\gamma$ KO mice because of their role in membrane and mitochondrial metabolism. We expect to see the greatest neointimal thickening in cPLA$_2$ $\alpha$ KO since this isoform is most likely to be responsible for production of inflammatory prostaglandins, which can then potentiate smooth muscle cell migration and proliferation. The results will be important to determine whether drugs to inhibit one or more of these enzymes could decrease vascular disease progression after angioplasty in diabetic patients.
Hey! Aberrant Salience Impacts Cognitive Control of Patients with Schizophrenia

Cecilia Votta

Mentor: Alan Ceaser

Dopamine dysregulation is thought underlie symptoms of schizophrenia. A recent theory proposed by Kapur suggests that this dysregulation impacts salience assignment, important for attributing salience to events and thoughts and driving goal directed behavior. For patients, aberrant salience assignment may lead to symptoms like delusions and hallucinations. Interestingly, cognitive control deficits, which are thought to be tied to the pathophysiology of schizophrenia, may also be impacted by aberrant salience assignment. To test this we developed a novel task of cognitive control that separates updating, interference control, and simple maintenance. We administered this task to 20 patients diagnosed with schizophrenia. We also collected information about their clinical symptoms using the Chapman scales, Aberrant Symptom Inventory, the Scale for the Assessment of Positive and Negative symptoms. We predict that patients with higher aberrant salience will be more susceptible to irrelevant task distractors. We do not predict a relationship between aberrant salience and other cognitive domains, like updating and simple maintenance.
The purpose of this study is to examine the views of Asian-American grade school students and parents whose perspectives for decades have been ignored in the research literature. This study will concentrate on depicting the aforementioned lived educational experiences of Asian-American students and parents. Grade school students and their parents will be interviewed and asked to describe their experiences with and within the United States public school system. Attention will be focused on the model minority stereotype that has affected Asian-American students’ experiences at school, their relationships with non-Asians, and their self-defined identities. Comparisons will be made between students of different Asian-American ethnicities and generations residing in the United States.
In both humans and mice, Fibroblast Growth Factor (FGF) is upregulated following injury to the heart, and published studies have shown that FGF2 serves as a mediator in cardioprotection following cardiac stress or injury. It is currently unknown how FGF signaling is regulated in the adult heart and why the effects are only observed following injury. We hypothesized that FGF signaling may be repressed in the adult heart under homeostatic conditions and becomes reactivated following injury. A doxycycline-inducible, cardiomyocyte specific, constitutively-active FGF receptor mouse model (αMHC-rtTA, TRE-caFGFR1-myc) was utilized to test whether the cardiomyocyte has the capacity to respond to a cell autonomous FGF signal. Twelve- to 14-week old mice were fed doxycycline-containing (DOX) chow to induce caFGFR1 in cardiomyocytes. Histologic analysis showed significantly increased cardiomyocyte-cross sectional area in caFGFR1 hearts by one week following induction. Trichrome and H&E staining indicated an increase in fibrosis and myocyte disarray in caFGFR1 hearts. Gene expression analysis confirmed the presence of hypertrophy and fibrosis by one week and demonstrated that pathologic remodeling was underway by 24 hours. Western analysis to elucidate the in vivo mechanisms by which FGF signaling affects cardiomyocyte hypertrophy is currently under investigation. Experiments investigating the effects of administering targeted pathway inhibitors to prevent the development of the hypertrophy phenotype are also underway. The findings demonstrate involvement of FGF signaling in the development of a hypertrophic cardiomyopathy (HCM), a pathological condition characterized by preserved or enhanced systolic function, myocyte hypertrophy and disarray, and interstitial fibrosis. The mechanisms that result in hypertrophy are still poorly understood, but this new model of HCM could potentially provide valuable insight into specific mechanisms that regulate cardiomyocyte growth and remodeling in the adult heart.
Molecular dynamics simulations allow us to model and analyze the behavior of various molecules on an extremely small molecular scale. Various force fields can be employed to most accurately represent the conditions of molecules in solution. In response to the findings of recent studies regarding the accuracy of molecular dynamics force fields in comparison to experimental NMR data, we ran simulations on a pentapeptide of alanine (Ala5) using six different force fields, including AMOEBA variations, in both explicit and implicit solvent models for 40ns each. Using the data from the simulations, we can determine the conformations of the peptides. Fitting the data to Karplus curves, we found that our data often does not match experimental data given in recent experiments. However, while our findings are not quite in the range of experimental data, our data does follow certain trends regarding which force fields yield higher or lower secondary structure conformations. We intend to run more simulations on updated AMOEBA force field models with the hopes of more accurate results.
AD (Alzheimer’s disease) is a complex neurodegenerative disorder that impairs cognitive function and is characterized by two neuropathological hallmarks: extracellular amyloid plaques and intracellular neurofibrillary tangles. There is strong evidence that apolipoprotein E (ApoE) isoforms differentially affect the probability of amyloid deposition (ApoE4>ApoE3>ApoE2) and therefore shift the onset of AD by modulating the aggregation and/or clearance of amyloid-beta (Aβ). Astrocytes produce the majority of apoE in the CNS and existing evidence suggests that they are one of the main cell types in the brain that play a central role in the clearance of Aβ through apoE receptors like LDLR and LRP1. In this study we hypothesize that apoE isoforms influence the apoE receptor levels in astrocytes and hence modulate the uptake and degradation (clearance) of Aβ. By culturing immortalized astrocytes derived from apoE2, apoE3, and apoE4 knock-in mice, we measured the LDLR and LRP1 protein levels in the cells and specifically on the plasma membranes by surface biotinylation. Further, in astrocytes we assessed the cellular uptake of exogenously incubated cell secreted Aβ by ELISA. We found that the ApoE2 astrocytes had significantly higher levels of total and PM LDLR and LRP1. The LDLR and LRP1 levels in ApoE3 and apoE4 astrocytes are not significantly different, though apoE3 trends toward higher levels. Further, we observed the corresponding pattern of Aβ uptake to LDLR levels in apoE2, apoE3, and apoE4 astrocytes (apoE2> apoE3>apoE4). We conclude that ApoE isoforms influence the cellular and PM levels of LDLR and LRP1 and probably impact the clearance of Aβ in astrocytes. Therefore, modulating the levels and activity of apoE receptors and transporters may provide new opportunities for developing AD therapeutics.
Locating Impact Craters from the Stardust Interstellar Collector Foils and New Methods of Determining Crater Origin

Harison Wiesman

Mentor: Christine Floss

In this study we focus on the analysis of the Stardust interstellar collector foils in search of craters caused by the impact of interstellar dust and new methods of distinguishing these craters from other craters and debris. Interstellar dust grains are formed inside stars, usually toward the end of the star’s life cycle. When collected and studied in a laboratory, these grains provide information on the properties and evolution of stars based on the grain’s isotopic composition. From 1999 to 2006, in addition to collecting cometary particles, the NASA Stardust mission collected interstellar dust by exposing a collector made from silica aerogel tiles and aluminum foil to interstellar space. Using a combination of scanning electron microscope imaging and Auger spectrometer imaging, craters have been positively identified in the aluminum foil strips and are beginning to be searched for traces of interstellar dust.

The interstellar dust will have impacted the collector foil normal to its surface, while other particles and debris will have impacted at an oblique angle. To help determine whether craters were caused by interstellar dust or spacecraft debris and other particles, two hypervelocity test shots were preformed at off-normal angles. In these test shots, various materials bombarded strips of aluminum foil. Through Auger elemental analysis these test shots have helped to show deposited material from the impacts creating a spray pattern out from the crater. When applied to craters on the stardust interstellar collector this method will be useful to help distinguish crater origin.
The cycling of sulfur in global oceans is impacted by the microbial processes involving sulfur oxidation occurring at deep sea hydrothermal vent systems. These reactions work to redistribute sulfur-containing compounds throughout the world’s oceans. Here we examine the effects of a range of temperatures and pH on sulfur speciation in two separate strains of sulfur-oxidizing bacteria, *Thiomicrospira thermophila* and *T. crunogena* were both isolated from hydrothermal systems of the East Pacific Rise and obtain energy for cellular processes from the oxidation of partially reduced sulfur compounds. Both were grown using thiosulfate (S\textsubscript{2}O\textsubscript{3}\textsuperscript{2-}) as the electron donor under aerobic conditions with variations in the pH and temperature. Under optimal temperature (35°C) and pH (initially 7, unbuffered) with exponential growth, *Thiomicrospira* produce a ≥1:1 molar ratio of thiosulfate consumed: sulfate produced while generating a small, stoichiometric portion of elemental sulfur indicating the production of another oxidized, sulfur-containing compound, possibly sulfur dioxide. When pH is buffered at 5.6 with a range in temperatures from 35-45°C, the reproducible ratio obtained of 1:2 indicates a stoichiometric balance of thiosulfate and sulfate with negligible elemental sulfur production. In both strains, sulfate production is dependent on pH with a reduction in the rate as the net change in pH is increased. Future work analyzing stable isotopic fractionation of sulfur compounds produced by microbial growth can be used to better understand microbial activity under variable environmental conditions.
Nucleon superfluidity is studied within the context of neutron stars. We present an in-depth analysis of BCS theory using realistic nuclear potentials and consider the impact of short-range correlations on the neutron pairing. Gap calculations are incorporated into neutron star cooling simulations and the significance of the $^3P_2-^3F_2$ channel in various hadronic cooling models is closely examined. An analysis of the $^1S_0$ gap in neutron matter suggests short-range correlations can drastically alter the magnitude, density range, and temperature dependence of the gap. While the newly constructed $^1S_0$ gap does not significantly alter the nature of neutron star cooling, ongoing calculations attempting to incorporate the effects of short-range correlations and in-medium polarization on the $^3P_2-^3F_2$ gap will likely have significant consequences for hadronic cooling models.
This work documents formal and informal research on the fashion culture in Dakar, Senegal. It draws upon personal interviews, secondary sources such as essays, photography, and fashion illustration, and observation of Dakar Fashion Week 2012. The text focuses on personal identity in fashion, globalization, and the Western construction of African “authenticity” and “Africanness,” as well as the challenging of that construction by fashion designers from all over the African continent. Inspiration for the research was born from experiences with black youth in Chicago, Illinois and the growing trend of promoting black identity through afrocentric clothing, as well as growing numbers of “tribal” garments in mass-market clothing stores. This work offers first-hand insight into the evolving attitudes of Senegalese designers and consumers towards fashion culture, as well as a specific context to understand globalization in the world of fashion.
Edgar Degas’ ballet imagery makes up one of the most prominent and enduring portions of his body of work, a subject he revisited consistently throughout his lifetime. The Paris Opera and its ballet were the center of cultural life for the nineteenth-century bourgeois city dweller, as Parisians of all classes could attend its performances. Any depiction of the Opera, its singers, or its dancers engaged with a rich cultural context of contemporary representation that ranged from idealizing newspaper reviews to darkly humorous and often critical caricatures of young dancers to descriptive passages in the novels of Balzac and Flaubert. This project focuses on how Degas’ interaction with the contemporary Opera culture illuminates his artistic interests. Degas’ interest in the ballerinas of the Paris Opera, particularly in his works completed between 1860 and 1890, transcends his commitment to depicting the realities of an important facet of contemporary bourgeois life. Degas used the Opera to mirror his own artistic process, exploring the idea of artifice and the engagement of the spectator.

I explore the relationship between popular, contemporary Opera imagery and Degas’ works. I look at his conscious decision to include the mechanics of the theatre despite a tradition of the stage panorama, scenes from operas presented as history paintings, free of any references to the illusion of the stage. I also compare the specific subjects within the confines of the Opera ballet—interactions in the wings, rehearsals, views from the audience—to those in the caricatures and texts focused on exposing what went on “behind the scenes.” Degas’ interest in the Paris Opera Ballet at this point in his career consisted of deconstructing the illusionistic façade of the Opera in order to focus on a process that could be applied to art in general, including his own.
Chen Man skyrocketed to fame with her covers for Vision Magazine (青年视觉杂志), which spanned from 2003 to 2005. Each depicted a different woman challenging traditional Chinese conventions of demure gaze, small lips, and double eyelids as the epitome of female beauty and femininity. This project studies Chen Man’s Vision series as a lens on her aggressive, yet decidedly non-feminist approach in digital manipulation and contemporary Chinese photography, which ultimately diversifies socially acceptable forms of beauty that transcend gender, class, and ethnicity. An analysis of her work reveals a deliberate counter-reaction to a globally standardized notion of beauty as increasingly Caucasian. Chen retains authentic elements of traditional Chinese culture, from gender identity created by Peking Opera stage makeup to white skin as a trait of the elite class during the Imperial dynasties. Additionally, Chen’s use of makeup and digital manipulation to create artificial fantasies alludes to Chinese myths about shape-shifting women as a method historically used to imagine a purely aestheticized female ideal or “hyperfemininity,” a beauty so unattainable that it could only exist in a nonhuman form. This ultimately demonstrates Chen Man’s work as a prominent change in the method of promising beauty as a product of natural health that magazines and advertisers typically use to shape ideal self-images for consumers.
This study examines the regulation of melanocyte stem cells (MSCs) in zebrafish, an important aspect of zebrafish development. These cells are significant targets for scientific inquiry due to their ability as adult stem cells to self-renew and to maintain their target cells over many years of turnover. The overall purpose of this study would be to shed light on the regulatory mechanisms for adult stem cells in mammals in vivo, a critical step in unlocking their therapeutic potential. As melanocyte stem cells (MSCs) have not yet been isolated, any inferences about them must be elucidated indirectly by counting the daughter cells, the melanocytes.

In zebrafish embryos, we can ablate the larval melanocyte pattern with a mutation in the *mitf-ts* gene, which causes ablation of these direct developing melanocytes at 32°C and allows for their replacement by cells arising from MSCs. We can also stop MSC establishment using AG1478, which blocks the ErbB signaling pathway essential to establishing stem cells. Applying submaximal concentrations of AG1478 allows the establishment of a small fraction of MSCs while significantly decreasing the MSC population in the zebrafish. This resultant reduction in MSC number results in a “stem cell in a vacuum” paradigm, in which we hope to determine if MSCs can fully regenerate after partial ablation by comparing the cell counts for each AG1478 concentration to determine the level of MSC regeneration.

Our experiments show that reducing the number of MSCs in embryos treated in 2.5 μM, 2.9 μM and 3.2 μM AG1478 plateau in melanocyte development compared to control embryos, indicating new MSCs are not being established in response to the ablation, reflecting an asymmetric division model for MSCs where the melanoblasts, not the MSCs, are flexible in number.
Document classification is a topic in information science. In this study, I show an algorithm for automatically classifying text documents into formal or informal style. To get enough information of formality, people use large training corpora in many algorithms. This work proposes a method for extracting formality markers from a small, classified training corpus for assessing the formality of emails content using markers. The research compares the effectiveness of the classifiers in the built algorithm and two other classification methods. As a test case, I use Enron Email Database, a relevant email database of Enron Corporation, extract formality features from it and evaluate the performance of the markers in each algorithm. The results of this study show that several hundred classifiers are able to predict the classes of new texts with high accuracy. The training corpus for text classification does not have to be large to provide enough information for document classification. Thus, it greatly improves the speed of current classification algorithms.
The Medici family hold an unparalleled position in Italian and world history as adept merchants, shrewd politicians, and generous sponsors of the arts. Its members were noted for their patronage of eminent artists such as Donatello and Michelangelo. However, amid the numerous paintings and sculptures that the Medici commissioned, it is easy to overlook other “minor” arts that they also patronized. During the reign of Francesco I de’ Medici (Grand Duke 1574-87), Italian craftsmen manufactured the first pieces of soft-paste porcelain in Europe. Although Medici porcelain derived from Chinese blue-and white porcelain and Italian maiolica (a type of earthenware), its production signaled a shift from mere consumption to personal manufacture. The invention of Medici porcelain was thus a decisive turning point in the European response to porcelain as a medium. Unfortunately, very little information exists regarding direct Chinese-Italian porcelain commerce in the early modern era (c. 1500-1800 CE). Therefore, it is likely that this flourishing trade was conducted through intermediaries such as merchants trading to and from Constantinople. Understanding how Chinese porcelain was brought to Italy and who brought them can shed light on the specific forms and decorative styles that impacted the Medici products. These pieces present an intriguing case study for examining porcelain’s role as a barometer of international political power, in addition to its prevailing role as an indicator of elite status.
Toward a Better Understanding of…

**FUNCTIONAL ROLE OF TRANSMEMBRANE ACCESSORY SUBUNITS IN THE GENERATION OF NEURONAL POTASSIUM CHANNELS**

*Michael Yang*

*Mentor: Jeanne Nerbonne*

Voltage-gated potassium (K\(v\)) channels, which play critical roles in regulating neuronal excitability, consist of pore-forming (\(\alpha\)) subunits and accessory subunits. The Kv4 \(\alpha\)-subunits of rapidly activating outward (A-type) Kv currents (I\(_A\)), for example, complex with cytosolic K\(^+\) channel interacting proteins (KChIPs) and dipeptidyl peptidases 6 and 10 (DPP6 and DPP10) among other accessory subunits. The DPPs are transmembrane auxiliary subunits that have been shown to regulate Kv channel current properties independently of KChIP in heterologous cells and to increase surface localization of Kv4.2 without observably affecting total Kv4.2 (or DPP) levels. The biochemical experiments here have characterized small hairpin RNA sequences for RNA-mediated reduction in the specific expression of DPP6 or DPP10. These sequences will be used to characterize the role of DPPs in the electrophysiological properties of neuronal Kv channels through the observation of how decreased protein levels affect cortical pyramidal neurons isolated from mouse visual cortices.
Where has ecofeminism gone? In its first decades, ecofeminism enjoyed popularity and developed diverse analyses of a wide range of topics. However, the movement was often criticized for being essentialist and fractured and eventually the term “ecofeminism” largely fell out of use. However, the interaction of feminism and ecology remains present in areas such as animal rights, environmental justice, and queer and posthumanist theories. This work locates the original tenets of ecofeminism within contemporary movements by analyzing the works and arguments of current theorists within these areas. The study concludes that ecofeminism remains alive and well, if only in practice rather than name, and in fact provided much of the theoretical foundation for contemporary feminist-environmental thought.
Mycotoxins are toxic metabolites produced by fungi. Aflatoxin is one type of mycotoxin. Animal exposure to aflatoxins, through ingestion of contaminated food, is known to cause liver injury in livestock, and human exposure to these toxins is an important risk factor for the development of liver cancer. These exposures are common in Sub-Saharan Africa and Asia, but some North American exposure also occurs. Although aflatoxin-induced hepatotoxicity is well recognized, the systemic metabolic and hepatic regenerative responses to acute and chronic toxin exposure have not been well characterized. In this study, we developed a mouse model of AfB1-induced stunting and investigated the relationships between such stunting and liver and gut injury. The metabolic and regenerative responses that occur in mice subjected to dietary aflatoxin B1 were characterized using tools well-established in the Rudnick lab for analyses of regeneration.
The temporal discounting paradigm typically has participants choosing between an immediate and a delayed reward, and results have shown that discounting (i.e., the decrease in the subjective value of a reward as the delay to its receipt increases) is much better described by a hyperboloid function than by the exponential function long favored by economists. The present study extended the discounting framework to choice situations in which both rewards are delayed: a smaller amount of money available sooner and a larger amount available later. The data were consistently better described by a hyperboloid than by an exponential discounting function. The common-aspect attenuation hypothesis—according to which the common aspect of the choice alternatives (i.e., the time until the sooner reward is available) receives less and less weight in the decision-making process as the time to the sooner reward increases—was shown to provide an excellent description of the data.
It is generally shown that thermal conductivity of a ZnO bulk system is an important property of thermoelectric materials in transferring waste heat to electricity. In this work, we will study the computational method of calculating ZnO bulk system thermal conductivity using the Equilibrium Molecular Dynamics (or Green Kubo) simulation on MedeA and LAMMPS. The Green Kubo method and Non-equilibrium Molecular Dynamics (NEMD) method will be compared. The Green Kubo method with periodic systems is doing a better job with the zinc oxide system. We will also analyze the different factors affecting the accuracy of the thermal conductivity calculation. We have a result of ZnO bulk system at 300K that has a thermal conductivity of 123W/mK, which has proven to be reasonably close to the experimental data. With this method and code, we are able to do more calculations on the thermal conductivity of nanowire ZnO and doped ZnO bulk systems.
The Effects of Mutant CRX on Photoreceptor Gene Expression

Alan Zhang

Mentor: Shiming Chen

The Cone-Rod Homeobox (CRX) transcription factor coordinates transcription of genes necessary for photoreceptor function. Mutations in human CRX have been associated with dominant forms of Leber's Congenital Amaurosis (LCA), Cone-Rod Dystrophy (CoRD), and Retinitis Pigmentosa (RP). To model CRX disease, we created two Knock-IN mouse lines which carry distinct types of mutations implicated in human disease. Crx DN carries a frame-shift deletion mutation in its trans-activation domain, maintaining ability to bind DNA but resulting in the truncation of CRX protein. Crx LF (Loss of Function) carries a substitution mutation in the DNA binding domain. LF protein showed reduced ability to bind DNA in vitro. In addition, we found that the inclusion of a neomycin cassette in intron 3-4 of each Knock-IN lowered the mutant CRX levels. We maintained both high expressing (DNH and LFH, neo-) and low expressing (DNL and LFL, neo+) mouse lines to see how mutant expression level impacted disease phenotype. DNL/+ and DNH/+ both show dominant phenotype but the DNH/+ phenotype is much more severe. DNH/+ mice have strongly impaired retinal function, significant ONL thinning by 3 months of age, and reduction of target gene expression—including key photo-transduction and visual cycle genes—which are required for vision. LFL/+ and LFH/+ both display normal retinal function and outer segments and outer nuclear layer thickness with only mild down-regulation of CRX target genes. Neither Crx mutant could drive gene expression in vitro. When co-transfected with WT CRX, DN reduced the overall expression more strongly than LF. This indicates that the dominant negative allele interferes with the WT allele activity more than the loss of function allele. These models demonstrate that both mutation type and expression level greatly affect phenotypic outcome and provide insight into the heterogeneity of pathology in human disease.
Opioid Receptor Like-1 (ORL1) Intracellular Trafficking and JNK Signaling Require C-Terminal S363

Mentor: Michael Bruchas

Opioid Receptor Like-1 (ORL1) is the least understood opioid receptor and plays a key role in pain modulation, opiate tolerance, and responsivity to stress and anxiety. It has been reported that c-terminal phosphorylation at serine (S), threonine (T), and tyrosine (Y) residues are required for mu and kappa opioid receptor internalization, desensitization, arrestin recruitment, and mitogen-activated protein kinase phosphorylation (pMAPK). To determine the molecular mechanisms that mediate ORL1 internalization, desensitization, and pMAPK we mutated c-terminal residues of human ORL1. We generated alanine mutations at T362/S363, S363, T362/S363/T365, and S337/346/351 in the ORL1 c- terminus. Using wild type and mutant YFP-tagged ORL1 receptors expressed in HEK293 cells, we visualized and compared nociceptin (noci; ORL1 agonist)-induced ORL1-YFP internalization. ORL1-YFP internalized within 15-30 minutes following noci treatment. In contrast, S363A of ORL1-YFP significantly blocked internalization. In addition, we determined the time course and concentration-dependence of ORL1-YFP-mediated pMAPK. noci caused robust increases in pERK and pJNK cascades. ORL1-YFP- induced pERK was rapid and peaked at 10 minutes following agonist exposure while pJNK peaked at 30 minutes. C-terminal serine 363 mutants of ORL1-YFP showed markedly reduced pJNK MAPK phosphorylation. Further, we determined that ORL1-YFP internalization is blocked via arrestin 3 and GRK3 shRNAs, and that ORL1-S363A internalization and pJNK can be rescued via expression of a dominant positive arrestin 3 (DP-Arr3). Together, these data implicate GRK/arrestin in ORL1 MAPK signaling, and highlight the potential for the development of functionally selective ORL1-ligands.
Plant biologists use *Arabidopsis thaliana* as a model organism to study its interaction with the pathogen *Pseudomonas syringae*. When attacked by *P. syringae*, *Arabidopsis* triggers several hormonal signaling pathways and among them, the jasmonate (JA) signaling pathway is required for susceptibility. Since the Kunkel lab had identified a JA hypersensitive mutant (*jah2*) and cloned a candidate *JAH2* gene, my job was to confirm the molecular identification of the *JAH2* gene and to investigate the role of *JAH2* in JA signaling. This involved generating transgenic lines to determine whether genomic and cDNA clones of the putative *JAH2* gene restore the wild type phenotype to the *jah2* mutant. I also used RT-PCR to detect *JAH2* transcription levels in response to JA treatment. The complementation tests showed that the genomic *JAH2* complemented the *jah2* mutant, but results with the cDNA clones of putative *JAH2* were inconclusive. This discrepancy may result from incomplete cDNA clones of *JAH2*, so further experiments should be done to verify the actual 5' end of the *JAH2* mRNA. The *JAH2* gene expression experiment showed more *JAH2* transcription with JA treatment than without JA treatment, suggesting that the *JAH2* transcription was induced by JA. To confirm this result, I need to investigate the correlation between *JAH2* expression and other JA responsive genes.
Alzheimer’s disease (AD) is a neurodegenerative disease that impairs cognition and causes behavioral changes. Evidence suggests that AD is caused by a cascade of pathological events, beginning with the deposition of toxic amyloid beta (Aβ) peptide in the brain. This is called the amyloid-cascade hypothesis. The Apolipoprotein E (APOE) genotype is the strongest genetic risk factor for AD due to its role in clearance of amyloid beta. Previously we have shown that increased levels of low density lipoprotein receptor (LDLR) result in a significant decrease in apoE levels and a reduction in Aβ aggregation. Thus, modulation of LDLR levels may be important in AD treatment. Inducible Degrader of LDLR (IDOL) is an E3 ubiquitin ligase that ubiquitinates LDLR and targets it for degradation. Recently, we identified myosin regulatory light chain 12b, a brain-specific myosin regulatory light chain, as a novel IDOL interacting protein and a potential target in AD treatment. In this study, we sought to assess the effects of Myl12b on AD pathogenesis. We first measured the expression patterns of Myl12b and IDOL in various cell types, including neurons, astrocytes, and microglia as well as in several major tissues. Preliminary results showed that over-expression of Myl12b significantly lowered levels of LDLR compared to control. This data suggests that Myl12b may play an important role in regulating AD pathogenesis. Although the precise mechanism by which Myl12b interacts with IDOL has yet to be determined, these results show that Myl12b is a promising new area of AD research.
Compared to somatic sensations such as pain, temperature perception, and proprioception, the sensation of itch has long been understudied and poorly understood despite being a prevalent side effect of post-operative morphine pain treatment. Molecular studies reveal that the primary transmitter for itch at the first sensory synapse of the dorsal horn is gastrin releasing peptide (GRP), which targets gastrin releasing peptide receptor (GRPR). Since the physiological properties of GRPR signaling in the dorsal horn have not been previously investigated, we aimed to characterize it using Ca²⁺ imaging technique on mouse dorsal horn neuron cultures. Additionally, we evaluated the use of a transgenic line of fluorescently tagged GRPR (GRPR-eGFP) for specifically studying dorsal horn neurons that express GRPR. Since GRPR is a Gq linked G-protein couple receptor (GPCR), it is associated with phospholipase C activation and liberation of inositol triphosphate (IP₃) and diacylglycerol, which leads to intracellular Ca²⁺ release. I observed GRP induced Ca²⁺ transients in approximately 10% of dissociated dorsal horn neurons. The Ca²⁺ transient was decreased by an inhibitor of phospholipase C signaling, U73122. Removal of extracellular Ca²⁺ did not prevent GRP induced Ca²⁺ transients, suggesting the source is intracellular. This was confirmed when we found that depletion of intracellular Ca²⁺ with a SERCA pump inhibitor, thapsigargin, prevented GRP induced Ca²⁺ transients. Furthermore, 2-APB, an inhibitor of the IP₃ receptor, abolished GRP induced Ca²⁺ transients. Finally, confirmed that GRP induced Ca²⁺ transients occurred in cells expressing GRPR by using a FITC filter to illuminate GRPR-eGFP expressing cells to determine overlap with cells responding to GRP with a Ca²⁺ signal.

In summary, we have characterized the mechanism of GRP induced Ca²⁺ signals using a native system of dissociated dorsal horn neurons, and we are verifying the specificity of the GRP signal using a genetic model of fluorescently tagged GRPR.
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A logo for the Office of Undergraduate Research, on the front cover of this publication, consists of an "impossible triangle" within a starburst. To some, the triangle evokes the challenge of puzzles to be solved or the eternal research question "How does that work?" To others, the triangle represents the Greek letter Δ, the mathematical symbol for change.

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