# Spring 2015 Undergraduate Research Symposium

**Friday, April 17, 2015**

2:30 p.m. – 7:00 p.m.

## Agenda

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<td><strong>Merle Kling Undergraduate Honors Fellowship Senior Presentations</strong></td>
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<td>2:30 p.m. – 6:00 p.m.</td>
<td><strong>American Culture Studies Undergraduate Research Colloquium</strong></td>
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<td>4:20 p.m.</td>
<td><strong>Keynote Address:</strong> <em>The Yellow Brick Road: Mentoring through Paths of Discovery</em></td>
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<td>4:40 p.m. – 4:50 p.m.</td>
<td><em>Individual Differences in Hedonic Capacity, Depressed Mood, and Affective States Predict Emotional Reactivity</em></td>
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<td>4:50 p.m. – 5:00 p.m.</td>
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<td>5:00 p.m. – 6:30 p.m.</td>
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# American Culture Studies Undergraduate Research Colloquium

The Ginkgo Room, Olin Library  
Friday, April 17, 2015  
2:30 p.m. – 7:00 p.m.

**Program Chairs:**  
Iver Bernstein, Director of American Culture Studies  
Heidi Kolk, Associate Director of American Culture Studies  
Máire Murphy, Academic Coordinator, American Culture Studies

## Agenda

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<td>2:40 p.m.</td>
<td><strong>Juliet Eisenstein</strong></td>
<td>Who Really Gets to Climb the Ladder of Success? Student Retention at the University of Austin and the Future of Higher Education Access</td>
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<td>3:00 p.m.</td>
<td><strong>Matt Cleary</strong></td>
<td>Obama the Socialist? American Media and the Prejudice against Socialism</td>
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<td>3:20 p.m.</td>
<td><strong>Elena Bell</strong></td>
<td>Different Paths, Similar Outcomes: The Relationship between Urban Governance, Concentrations of Poverty, and Disparities in Education in St. Louis, MO, and Houston, TX</td>
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<td>3:40 p.m.</td>
<td><strong>Vince Biase</strong></td>
<td>Modern Tort Reform in the United States: Rhetorical Spin and the “Legal Wheel of Fortune”</td>
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<td>4:00 p.m.</td>
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<td>4:40 p.m.</td>
<td><strong>Courtney Oben</strong></td>
<td>She Don’t Even Know It: Expressions of Misogyny, Hyper-Violence, and Sexually Aggressive Themes in Rap Lyrics and Hip-Hop Culture</td>
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<td>5:00 p.m.</td>
<td><strong>Alex Leichenger</strong></td>
<td>“He’s the Jew”: Assimilation, Ownership and Colorblind Capitalism in American Professional Basketball</td>
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<td>5:20 p.m.</td>
<td><strong>Lisa Gosine</strong></td>
<td>For (Y)our Best Interest: The Minimum Draft Age Requirement and the Conflicting Goals of Profitability in the NBA</td>
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<td>5:40 p.m.</td>
<td><strong>Sam Lai</strong></td>
<td>The Jade Sage Chronicles: Creating a Suburban Mythology</td>
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<td>6:00 p.m.</td>
<td><strong>Ashley Brown</strong></td>
<td>The Effects of Racial Bias on Black Men</td>
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## M ERLE K LING U NDERGRADUATE H ONORS FELLOWSHIP S ENIOR P RESENTATIONS

Arc Presentation Room, Level A, Olin Library  
Friday, April 17, 2015  
1:30 p.m. – 3:30 p.m.

### A GENDA

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<th>Time</th>
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| 1:30 p.m. | **REBECCA WANZO,**  
**INTERIM DIRECTOR OF THE  
CENTER FOR THE HUMANITIES AND  
ASSOCIATE PROFESSOR OF WOMEN,  
GENDER, AND SEXUALITY STUDIES** | **Welcome**                                                          |
| 1:40 p.m. | **SONYA SCHOENBERGER** | **Civilizing Combat: The American War in the Philippines, 1899-1902** |
| 1:55 p.m. | **MARIE DRAPER** | **Influence of Instructor Beliefs, Biases, and Language While Teaching Undergraduate Physics** |
| 2:10 p.m. | **LILY JACOBI** | **“Make Him Know Who You Are”: Agency and Victimization in the Lives of Trafficked Women** |
| 2:25 p.m. | **BREAK** |                                                    |
| 2:35 p.m. | **CHELSEA BHajan** | **Liming: A Reflection of Who We Are and Where We Have Been**     |
| 2:50 p.m. | **GYOONHO KONG** | **Translating a Hybrid Poet: Foreign Presence in the Poems of Yi Sang** |
| 3:05 p.m. | **ÁINE O’CONNOR** | **Marching Season: Identity, Memory, and Sectarian Politics in Northern Ireland** |
| 3:20 p.m. | **RECEPTION** |                                                    |
Presenters are listed alphabetically by last name.

FRAGMENTS OF THEATRE’S PAST: RECONSTRUCTING EURIPIDES’S PHAETHON
Ji Hyun Ahn, Alexander Booth, Alejandro Martinez, Alexander Mason, McKenna Rogan, and Ricardo Solis
Mentor: Rob Henke

Famous Greek tragedian Euripides authored more than ninety plays, only a few of which still exist in full length. Euripides’s play, Phaethon, the story of the sun deity’s son who almost burns the Earth, survives in only simple fragments of the original. Despite the myth’s popularity, its interpretations have varied widely. Our team set out to reconstruct Phaethon through examination of Euripides’s original fragments, consideration of the work of more recent scholars, and some degree of creative freedom. We wrote a collection of essays dealing with the issues of Phaethon’s characterization as an impulsive adolescent, the presence of a deus ex machina, the centrality of Phaethon’s parental figures, and Aeschylus’s influence on Euripides’s writing. These research essays then informed our writing of a full script for Phaethon, using the original fragments in combination with our own playwriting. This script was used in the staging of a workshop performance of Phaethon. Our research findings suggested a level of depth in Phaethon’s characterization that is not always found in more modern versions of the myth. We deemphasized his “rebellious teenager” qualities and focused instead on his status as a young man in the midst of an identity crisis, searching for his familial roots. Our research also pointed to the overlooked centrality of Merops and Clymene. As such, the structure of our final script emphasized their importance – placing the death of Phaethon relatively early on, developing Merops’s and Clymene’s relationship, and ending the play by highlighting their marital conflict. These findings, among others, informed our final product and led us to our goal of recreating the essence of Euripides’s original version of Phaethon.

ISOLATION AND CHARACTERIZATION OF NOVEL A4 MYCOBACTERIOPHAGE PHlavio
Katherine Alexander, Paul Felder, John Garza, and William Lyons
Mentor: Sarah C. R. Elgin

A new mycobacteriophage, Phlavio, has been isolated from soil taken from a shopping center in the Brentwood neighborhood of St. Louis. After obtaining the soil sample from a storefront, the sample was purified, isolated, and a high-titer lysate was harvested. Phlavio was found to produce smooth, slightly cloudy plaques of about 3.5 mm in diameter when using Mycobacteria smegmatis as a host. Electron micrographs show an isometric, hexagonal capsid that is 54 nm wide and 59 nm long with a tail length of 149 nm. Analysis using the restriction enzyme PstI showed that Phlavio’s genome length could be estimated to be 53,000 bp. Based on the estimated genome length, plaque morphology, physical appearance, and cuts made by SacI it was correctly predicted that Phlavio was a cluster A4 phage. The DNA sequencing results reveal a genome size of 51,373 bases and 88 coding genes. In annotating Phlavio’s genome, BLAST results reveal similarity to phages Sabertooth and TiroTheta9, both A4 phages with genome sizes around 51,370 bp. The presence of an S-integrase indicates that Phlavio is likely a temperate phage. TiroTheta 9 and Sabertooth both possess an S-integrase at gene 33 as well. Phlavio and Sabertooth both contain gene 59, which is absent in TiroTheta 9. Much smaller plaques were observed in TiroTheta9. Functional annotation of Phlavio’s genome reveals proteins that serve the same functions in TiroTheta 9 and in Sabertooth. Thus, this illustrates a conservation of genes amongst these A4 phages. In-depth investigations of Phlavio’s integrase, DNA methylase, frameshift at Gene 34, and antibiotic resistance aim to study unique features identified in some A4 phages.

RELATIONSHIPS OF DEPRESSED MOOD AND ANHEDONIA TO EMOTIONAL REACTIVITY:
EVIDENCE FROM PUPILLOMETRY
Gabriella Alvarez
Mentor: Deanna Barch

Understanding variation in emotional reactivity is crucial to understanding the mechanisms underlying distinct patterns of thought and behavior. Research investigating sensitivity to affective stimuli, demonstrates that a key impairment in major depressive disorder (MDD) is emotional functioning. With interest in garnering an understanding of the complex nature of MDD and the deficits associated with unique symptom manifestations, the goal of the current study was to investigate individual differences in two symptoms of depression. Specifically, this study explored the differential roles that depressed mood and anhedonia, a loss of experienced pleasure, may play in reactivity to emotional content in a non-clinical sample. In this study, participants viewed and rated positive, negative and neutral pictures. To assess reactivity to the images, participants’ change in pupil dilation, an indicator of cognitive and emotional processing, was tracked. Participants also completed self-report questionnaires that assessed hedonic capacity and depressive symptomology. Results showed that depressed mood and anhedonia related differently to pupil dilation and to the self-reported ratings of the images. Increased
anhedonia scores were related to greater pupil dilation during: a) image presentation and the rest period following positive pictures and b) the rest period following negative pictures. Depressed mood showed no relationship to pupil dilation. In contrast, depressed mood did predict blunted ratings to positive images. The current findings suggest that individual differences in anhedonia and depressed mood may demonstrate distinct roles at different stages (attention versus cognitive labeling) of emotional processing. These results have clinical implications for understanding emotional reactivity in clinical depression.

**Bacterial Vaginosis Is Associated with a Vaginal Epithelial Exfoliation Response**

Courtney Amegashie  
Mentor: Amanda Lewis

Affecting up to 75% of women worldwide each year, bacterial vaginosis (BV) is a globally relevant disease characterized as a dysbiosis of the vaginal microbiota. The purpose of this study is to quantify and compare the epithelial exfoliation response in women diagnosed as BV-positive, BV-intermediate, and BV-negative. St. Louis-area women enrolled in the Contraceptive CHOICE project were selected to participate in the present nested case-control study. Participants provided answers to a survey that included questions regarding matching criteria (age, race, total number of sexual partners) and presence of BV-associated symptoms. Participants also provided self-collected double-headed vaginal swabs, which were used to determine the number of exfoliated epithelial cells and to assess the sialidase activity in the vaginal fluid. The results of this study show that women diagnosed as BV-positive and BV-intermediate on the basis of Nugent score have indistinguishable levels of vaginal epithelial exfoliation. The number of exfoliated epithelial cells positively correlates with Nugent score and sialidase activity, two previously defined BV-associated features. The results from this study may serve in part to explain previous findings, as the data suggests that intermediate vaginal microbiota affect the vaginal epithelium, an important host barrier, in a similar manner as BV microbiota.

**Contrasting Localization of PARP-Correlated-Proteins (PCP) Suggests Multiple Roles in Regulating DNA**

Sonya Anderson and Adam Seroka  
Mentor: Douglas Chalker

*Tetrahymena thermophila* are ciliated protists that have two functionally differentiated nuclei. The polyploid macronucleus regulates somatic gene expression and is only transcriptionally active during vegetative growth. The diploid micronucleus is the germline nucleus and is transcriptionally active during conjugation. Poly-(ADP-Ribose)-Polymerases (PARP) are proteins that are involved in many diverse DNA regulating processes. PARP-correlated protein 1 (PCP1) and PARP-correlated protein 2 (PCP2) both have zinc finger-PARP and PADR1 conserved domains, but lack the catalytic domain typically found in PARP proteins. ZF-PARP domains are known to bind to DNA and are known to recognize DNA nicks for PARPs but have also been proposed to interact with other DNA structures like hairpin loops and DNA bubbles.

To study PCP1 and PCP2 in *T. thermophila*, we employed bioinformatics, genetic tools and microscopy. We transformed *T. thermophila* with PCP1 and PCP2 with YFP fusions to visualize our protein in vivo. Although PCP1 and PCP2 have similar conserved domains, they have differing gene expression and protein localization. PCP1 was highly expressed during early conjugative stages with less expression during the growth stage. PCP2 was highly expressed during vegetative growth and during the end of conjugation. PCP1 and PCP2 had contrasting localization; PCP1 showed strong micronuclear localization and weak macronuclear localization, whereas PCP2 only localized to the macronucleus. Given this data, we propose PCP1 and PCP2 are involved in DNA replication and repair.

**Hiring a Neglected Cohort: The Ex-Offender Employment Debate**

Gabriel Arguelles  
Mentor: Eileen G’Sell

When seeking employment, criminals face challenges with their record, lack of experience, lack of education, and low income as a result of the time spent away from civilian life. The goal of reaching maximum employment among former criminals requires, among other factors, lower re-incarceration (recidivism) and imprisonment rates. However, literature aimed at solving the unemployment obstacle for ex-prisoners has often fallen victim to narrow approaches dealing only with direct labor and employer reform. The lack of a focus on directly reducing recidivism rates to increase ex-offender employment results from a line of logic often expressed: since higher employment rates for ex-offenders would decrease crime, directly decreasing unemployment is the first goal. Although we see employment as a method to reduce crime, we should focus on reducing crime in the form of minimizing recidivism as a first goal to increase employment rates. What many fail to realize is that a direct decrease in recidivism rates would increase employability, thereby indirectly reducing the ex-offender employment rate. The federal government should take steps to expand the sealing of records, ban the criminal history question...
Hey! That’s Cheating: Cooperation within Pseudomonas fluorescens

Odion Asikhia
Mentor: Joan Strassmann

Interactions between organisms play an important role in promoting diversity in nature. Consider altruistic cooperative interactions. In these, forms of self-sacrifice occur for the well-being of the group. But at times cheaters, members that do not participate in cooperative interactions, appear. Theoretical studies suggest that the presence of cheaters should result in a reduced evolutionary fitness level for the group. Why then, do the bacteria Pseudomonas fluorescens (PF) contain cheaters in the presence of Dictyostelium discoideum? In our experiment, we will perform a competition between cheaters and non-cheaters. PF relies on iron for survival, but because iron is not easily accessible, they produce siderophores which bind and transport iron. Siderophore production is beneficial for the local group but costly for the individual. Since cheaters do not produce siderophores, they gain an evolutionary advantage because they do not expend energy to produce siderophores. We will knock out key genes within PF that allow for siderophore production (referred to now as PFX). Using PF and PFX, we will test three different conditions. Trial 1 where PF is grown by itself, trial 2 where PFX is grown by itself, and trial 3 where both are grown together in a 1:1 ratio. All three conditions will be done in a media solution composed of nutrients (excluding iron) needed for growth. We will limit the iron supply in the media solution so the bacteria’s growth are dependent on the use of siderophores. We predict the cheaters will out compete the cooperative members in trial 3. If our hypothesis is supported, then it is possible Dictyostelium discoideum may play a role in mediating the interaction between the cheaters and non-cheaters in nature. Our research hopes to provide insight not only into how cooperation first evolved but also how diverse communities are maintained by interactions between organisms.

7-Tesla Nuclear Magnetic Resonance in the Brain:
An Analysis of Varying Field Strengths in Functional MR Neuroimaging

Garrett W. Arosemena-Ott
Mentor: Marcus Raichle

Functional Magnetic Resonance Imaging (fMRI) of the brain employs gradients and electromagnetic perturbations in a high-strength static magnetic field to induce Nuclear Magnetic Resonance (NMR). Developed at a primary field strength of $B_0 = 1.5$ Teslas ($1.5T$), MRI research over the past decade has focused on the effects of a higher-strength $B_0 = 3T$ static field, driving a gradual shift to $3T$ hardware with its enhanced signal-to-noise and contrast-to-noise ratios (SNR, CNR); however, while the current reliability of MRI is adequate for a variety of clinical uses, fMRI of the brain continues to suffer from the inherently low contrast of the blood-oxygenation-level-dependent (BOLD) mechanism – the relatively low signal (and overall energy consumption) increase between activated and inactivated brain regions, in the order of +5-10% (and +1%). Therefore, although a further increase in primary field strength ($3T$ to $7T$) may appear to yield a straightforward solution, several factors could inhibit or otherwise diminish any clinical benefit to functional neuroimaging (i.e. artifact levels, scaling of physiological noise with field strength, voxel size effect dependence, etc.). In this study, we analyze potential confounds specific to fMRI, comparing data collected on both $1.5T$ and $3T$ MR scanners to extrapolate findings into a $7.0T$ primary field environment. Additionally, we investigate the effects of varying secondary ($B_1$) fields and field gradients as well as their interaction with the (changing) primary static field. Results indicate that while functional MR imaging of the brain at $7T$ could provide several attractive improvements over $1.5T$ and $3T$, including gains in net signal intensity and SNR, other changes associated with a higher-strength field, such as Chemical Shift, excitation frequency and wavelength, shielding and interference, and SAR issues could pose significant problems capable of eclipsing overall gains.

Faith, Age, and the Decision to Die

Jokubas Ausra
Mentor: Eileen G’Sell

Our research delves into the surging debate behind euthanasia, exploring the advantages and pitfalls of legalizing life-ending practices. Beyond the scope of ethical debate, our research reviews religion, age, and economics in correlation with the rising acceptance of this radical practice. Incorporating knowledge from scholars and medical experts, this inquiry abstains from moral arguments and instead looks ahead to the probability of euthanasia becoming reality in the Europe and the U.S. While experts can predict the economic implications that would arise from such legislation, the underlying ripple such laws would cause on the mentality and religious trends of societies can only be speculated through works of fantasy.
WHAT IF GOD WAS ONE OF US? ASSESSING THE LINKS BETWEEN RELIGIOSITY AND CEO DECISION-MAKING
Matthew Ayanian, Mathias Gesser, Michael Lory, and Michael Postetter
Mentors: Mark Leary and Robert Pollak

Previous research in the field of financial economics has demonstrated a link between the personal characteristics of executives and corporate decision-making. Some of this work has suggested a relationship between religious affiliation and attitudes towards risk, which may influence financial policy choices such as leverage and debt issuance. Our team explores how a chief executive’s religiosity affects decision-making in a corporate environment. We expand on previous studies by including a range of firm-level indicators that reflect investment decisions, financial policies and market performance. Our analysis relies on a sample of non-financial firms from the 2002 S&P 1500 Super Composite Index, whose performances we track until 2014. Since there are no official databases specifying CEO faith, we use county-level rates of religious adherence in each CEO’s place of birth, place of education and location of corporate headquarters as a proxy for CEO religiosity. Understanding how a CEO’s religiosity relates to her/his actions could influence firms’ decisions to hire or promote executives with attributes that are aligned with corporate strategy. However, such research could also open the door for discriminatory hiring processes that segregate individuals based on religious affiliation.

THE SOUND OF SILENCE:
LINGUISTIC PROFILING AND DISCRIMINATION AS A BARRIER TO ACCESSING HEALTHCARE IN ST. LOUIS, MO
Amee Azad
Mentor: John Baugh

The analyses provided herein confirm that racial discrimination in accessing healthcare does not require direct, physical contact between medical providers or staff and patients. Research indicates that Americans can infer race from hearing someone’s voice, thus providing clinic staff with potential opportunities to discriminate over the phone and prime the clinic’s patient population to be what the staff perceives as able to pay out-of-pocket, that is, based upon a combination of racial and linguistic stereotypes. In order to test this hypothesis, an audit study comparing male and female speakers of White Middle-Class English, Black Accented English, and Black English Vernacular was analyzed for the present study. The linguistic profiles were models for class and race. The data was collected from August through November of 2012 in St. Louis City and County. The author found significant racial discrimination, as African Americans were less likely to receive advice for their lack of insurance or symptoms than whites. Additionally, the author found that patients in socioeconomically disadvantaged and residentially segregated regions experienced much longer wait times to the calls left.

SKIN TONE ATTITUDES
Diane-Jo Bart-Plange
Mentor: Alan Lambert

Colorism is typically defined as systematic discrimination against individuals with darker skin. However, at least in the case of African Americans, emergence of “colorism” contains an inherent ambiguity: do such effects reflect a causal effect of skin pigmentation per se, or are such effects attributable to other phenotypic features (e.g. shape of nose) that are correlated with skin tone. The evidence on this point is somewhat mixed. That is, some studies suggest that skin tone may matter independent of phenotype, but other studies have failed to find such effects.

Our goal was to provide further insight on this matter. In our research, we used the same core set of high quality images of a series of Black male and Black female faces, but digitally manipulated the skin tone. This allowed us to generate a series of Black faces, each one having three parallel versions of that same face (i.e. light, medium, dark). Hence, skin tone was unconfounded from phenotype. Two experiments were conducted. Study 1 (N = 60) used a between subjects design, randomly assigning participants to render attractiveness and liking judgments of a series of Black faces that varied in their skin tone (light, moderate, dark). Study 2 (N = 60) used a within subjects design, with participants forming judgments of all three classes of faces. Neither study revealed any significant evidence of skin tone bias, although there was a small trend of negativity towards dark faces. Although further research is clearly needed in this area, these null findings highlight the need for caution in this area, as evidence for colorism may not necessarily be due to skin tone per se.
THE GLOBAL WARS ON TERROR:
A COMPARISON OF THE UNITED STATES’ AND RUSSIAN FEDERATION’S COUNTERTERRORISM POLICIES
Margaret Bavlsik
Mentor: Anika Walke

This research compares the sources identified as “terrorist” threats by the United States and the Russian Federation, and the two states’ counterterrorist responses to al Qaeda and the Chechen nationalist separatists, respectively. Focusing on the time period between 1990 and 2010, this comparison focuses on the question of why the two nations apply very similar counterterrorist policies to two radically different sources of “terror.” While al Qaeda is a transnational organization with the goal to reestablish an Islamic caliphate, the Chechen nationalist separatists are a localized loose movement of like-minded warlords attempting to achieve national independence. Despite these differences, both the Russian Federation and United States reacted with policies that consolidated power around the executive and prompted extensive military campaigns waged against the “terrorist” threats. This thesis also discusses the role of the “war on terror” narrative for both nations’ increased executive power, as well as the broader implications of society.

The interdisciplinary thesis relies on relevant scholarship, policy analyses, as well as statements by intelligence officers, government officials, and journalists. Russian and U.S. government documents, such as legislation and press releases, and news sources from both countries constituted the majority of primary sources. Statements released by al Qaeda and the Chechen separatists were also examined.

While much scholarly work has been done to examine the U.S. and Russian Federation’s counterterrorist policies as well as their respective “terrorist” threats, this thesis suggests the similar policies carried out by the two nations oversimplify the nature of the terrorist threats and focus on a problematic and short-term counterterrorist solution with troubling implications on a global perspective.

DESIGNING AN OPEN SPACE, INTERACTIVE VOLUMETRIC DISPLAY
Deko Becker-Ricketts
Mentor: Ed Richter

Recent advances in digital displays provided the world with high-definition images and interaction with 2D touch screens. But these displays fall short of the 3D interactive images — such as Tony Stark’s virtual computer used to design the Iron Man suit in thin air — sought after for generations. Our project, See3, explores the capability of producing a volumetric display in a gaseous medium that will create full-depth imagery and allow real-time user interaction. For our most recent prototype, we built and aligned low-viewing angle LED matrices to act as projectors into a haze medium whose intersections would create bright points, developing an image. This has drawbacks, as the bright points are currently too dim to notice compared to the surroundings. We are currently recreating the display setup at Osaka University by projecting several angles of the image onto a cylindrical haze screen. While this does not create the image in true space, we can infer where the image is based on these projections, and thus we can design a stylus and glove that know where the image is and can interact with it. We will also make use of infrared optical sensors similar to a Kinect camera to identify hand gestures without the glove or stylus. Further research will be done to explore replacing the haze with a safe gaseous compound that, when excited to specific energies, can emit visible photons and thus create the desired bright points in space. This portion of the research, modeled after a project called Felix3D in Stade, Germany, will be explored after a full understanding of the haze display has been realized. See3 finds extensive applications ranging from entertainment and education to design and surgical practice.

MODERN TORT REFORM IN THE UNITED STATES:
RHETORICAL SPIN AND THE “LEGAL WHEEL OF FORTUNE”
Vince Biase
Mentors: Maire Murphy and Heidi Kolk

Our research examines the tort-reform debate in the United States over the past twenty years from a cultural and political perspective. Focusing on major, defining cases and events in the contemporary debate, we look at the ways in which American political initiatives have appropriated mainstream news and public sentiment in an effort to further propagate their respective causes. Tort reform will serve as a lens for examining this deeply ingrained trait of American politics, allowing for a comprehensive evaluation of how certain lawsuits ascend to national talking points and produce significant public dialogue which echoes cultural and societal norms. In the context of tort reform, lawsuits that follow the aforementioned trajectory through various mass-media platforms are ripe for political adoption. National news stories such as McDonald’s “Hot Coffee” fiasco and Wendy’s “Chili Surprise” naturally foster a public consciousness about a particular issue, as well as a committed personal opinion. This project will work to pinpoint where these national discussions of tort reform cross a threshold of political significance and garner an immensely dynamic, rhetorical value in the context of a larger partisan movement.
COMPARATIVE GENOMIC ANALYSIS OF MYCOBACTERIOPHAGE MORI; A CLUSTER O PHAGE
Gabrielle Bleich, Benjamin Eisenberg, Phoebe Moh, Jon Zielke
Mentors: Kathy Hafer, Chris Shaffer and Sarah Elgin

Bacteriophages are viruses that infect bacteria. We report here on the isolation and genomic analysis of mycobacteriophage Mori isolated on Mycobacteria smegmatis. Mori belongs to the Cluster O phages. Prior to phage Mori, only 5 Cluster O phages have been analyzed. This group of phages is unique for their long tails and prolate head structure. Mori makes clear plaques on M. smegmatis that are typically 1mm in diameter. The genome length of Mori is 71,672 bp and annotation revealed 124 genes. There are three main blocks of the genome, transcribed leftward, rightward, and leftward, respectively. Although, there are a few genes transcribed in the leftward direction dispersed throughout the rightward block. Some interesting parts of the genome, including a 17 bp repeated sequence and AT rich sites, will be investigated. After analysis of Mori’s genome through comparison to other Cluster O phages, functions for 33 of the 124 genes were identified; examples include DNA methylase and DNA polymerase genes. There is a small gap approximately 150 bp upstream of the tape measure gene. Although gaps of this size are unusual for most phage, this gap is characteristic of most of the other O phages that have been annotated and could prove to be significant to some of the unique qualities of O phage. Also upstream of the tape measure gene is the tail assembly gene, gene 48, where ribosomal slippage at base 25838 occurs; two base pairs are skipped and the ribosome jumps from the first to the third frame. This occasional slippage allows for a short and long form of the tail assembly protein to be produced. Only 5 Cluster O phages have been annotated, which makes Mori’s investigation even more significant.

Alexander Booth
See Ji Hyun Ahn

WHITE MATTER INTEGRITY PREDICTS VERBAL FLUENCY AND DELAYED RECALL IN HEALTHY CHILDREN
Sophia Boreest
Mentor: Desiree A. White

In the present study, we analyzed whether brain microstructural white matter integrity of fifty-five healthy children (7-17 years old) predicted the total number of words (food/drink) produced in a 60 second semantic verbal fluency task and recall of a wordlist (18 words) after a 20 minute delay. White matter integrity was assessed using mean diffusivity (MD) and fractional anisotropy (FA) from diffusion tensor imaging (DTI). White matter of the corpus callosum (genu, splenium, and rostral body) and the hippocampus were our regions of interest (ROI). We selected these ROIs because they have been well established as related to language fluency and anterograde memory, respectively.

We controlled for age in all analyses as age was a significant predictor of both tasks assessed. Turning first to verbal fluency, findings revealed that FA of the rostral body significantly predicted (p=.002, R^2=.13) number of words produced. Similarly, MD of the rostral body trended towards significantly predicting (p=.11, R^2=.06) verbal fluency, over and above the contribution of the genu and splenium. In contrast to our findings regarding verbal fluency, FA of the hippocampus did not significantly (p=.57, R^2=.002) predict recall of the word list. MD of the hippocampus, however, trended towards significantly predicting recall of the word list (p=.06, R^2=.06).

Given the frequency with which the tasks in the present study are used in clinical and research settings, our findings provide important information regarding the neuronal structures underlying language and memory performance in healthy children. Understanding how white matter integrity predicts task performance in healthy children will allow future research to examine these relationships in children with neurodevelopmental disorders.

DIVIDE IN WHITE AND BLACK PERCEPTION OF BLACK MALE PRISONERS AND ITS EFFECTS IN THE BLACK COMMUNITY
Ashley Brown
Mentor: Douglas Flowe

In this work, I explore the difference in thought that black and white people have to black prisoners and the effects which these different opinions produce in governmental policies and in the black community. The first part of this project briefly explores the origin of how blacks and whites tend to view the justice system and the consequences that have resulted from these various perspectives. This includes the creation of three strikes laws, stand your ground laws, and capital punishment, all of which have contributed to disproportionate profiling, mistreatment, arrest, murder, and incarceration of black men. Using psychological studies, I also examine how inherent racial biases harbored by blacks and whites lead to different perceptions of black criminals.

To analyze exactly how these laws affect particular black men, I use the theory of multidimensionality, which is very similar to the theory of intersectionality. It takes into account different aspects of identity – race, sex, gender, socioeconomic status – and acknowledges
the hierarchy that develops between these identifiers under various circumstances. I frame personal and second-hand narratives, newspaper articles, and psychological studies around this framework to better understand the root of the creation and the various effects of prejudicial laws. Through the work, I have gained a better understanding of the cause of the recent violence enacted against black men and have learned what measures can be taken to end discrimination against black men.

I AM NOT WHAT I EAT:

**Dictyostelium discoideum and Bacterial Food Densities**

Alicia Canas

Mentors: David Queller, Joan Strassman, and Debra Brock

Food is not easy to find. To solve this issue, soil-dwelling microorganisms may form symbiotic relationships with their food source. These relationships could be affected by environmental factors such as food distribution. Research has shown that about one-third of clones of the soil-dwelling amoeba, *Dictyostelium discoideum*, solve this problem by carrying food bacteria for future use. We refer to clones that possess this ability as farmers. Clones that do not carry bacteria are called non-farmers. We investigated whether a relationship exists between farming and the amount of preferred food available, which would mean farming is a quantitative trait rather than a dichotomous trait. We hypothesized that abundant preferred food may make the symbiotic relationship unneeded and too costly for farmers, or conversely, this excess food may prevent non-farmers from completely clearing food bacteria. To test these hypotheses we used five non-farmer clones and five farmer clones grown on three different concentrations of their preferred bacterial food source, *Klebsiella pneumoniae*. We found that farmer clones transport bacteria with the same frequency regardless of bacterial density while non-farmers are unable to farm regardless of bacteria abundance. This suggests that for these farmers and non-farmers, the symbiotic trait is dichotomous and not dependent on food abundance.

THE ROLE OF THE MANEABA IN ADAPTATION TO CLIMATE CHANGE IN KIRIBATI

Janice Cantieri

Mentor: Bret Gustafson

This research provides an ethnographic analysis of the impacts of climate change and sea level rise in the Republic of Kiribati, a small island nation in the Central Pacific. Kiribati is a series of thirty-three low-lying coral atolls and one phosphate island that average between two and three meters above sea level. There have already been significant damages caused by the rising sea, including the loss of property, water contamination, and the loss of food resources. The villages practice a primarily subsistence-based lifestyle that revolves around cultural, social, and economic relationships to the *maneaba*. The *maneaba* refers to the physical community buildings in each village, but also to the village’s social network, extended family structure, and traditional leadership system in place in each village. In recent years, villages have been forced to adapt to the changes caused by the rising sea level, while simultaneously transitioning rapidly to a more cash-centered economic structure as the sea continues to rise. Efforts to address the impact of rising seas have accelerated this emphasis on the cash economy, which paradoxically, has intensified a feeling of impending loss, detachment, and inevitable displacement. The research analyzes these changes on the *maneaba* cultural system in Kiribati, and argues that rather than simply “adapting,” the Kiribati *maneaba* culture has allowed villages to remain remarkably resilient in the face of drastic environmental change. However, it is this very network that will be threatened as the sea continues to rise.

EFFECTS OF EARLY LIFE STRESS ON RESTING-STATE FUNCTIONAL CONNECTIVITY IN HIV-POSITIVE INDIVIDUALS

Gina Chang

Mentor: Beau Ances

Human immunodeficiency virus (HIV) infection and high levels of early life stress (ELS) have independently been associated with alterations in brain function. Previous studies have implicated both processes with changes in functional connectivity measured using functional magnetic resonance imaging (fMRI) in the resting state, and one study has specifically demonstrated a significant interaction between HIV and ELS on brain volumetrics and cognition. However, the functional consequences of ELS in HIV+ individuals are unknown. This study served as a preliminary investigation of the impact of ELS on resting-state functional connectivity MRI (rs-fcMRI) at the brain network level in HIV+ individuals. One hundred and nine HIV+ individuals were assigned to a high (n=64) or low (n=45) ELS group based on responses to a validated self-report ELS questionnaire. All participants also underwent functional neuroimaging. Analyses of variance (ANOVA) were performed using the level of ELS and composite correlations within and between 13 resting-state brain networks. We hypothesized that individuals with high ELS would demonstrate significantly decreased connectivity with and within the default mode network (DMN), the network most active in the absence of tasks. In addition, we hypothesized that ELS would significantly
Impact connectivity with or within the frontoparietal task control, dorsal attention, and cingulo-opercular task control networks, all of which are associated with cognitive behaviors found to be affected by ELS in prior neuropsychological studies in otherwise healthy individuals. A significant difference in rs-fcMRI due to ELS was observed in 4 intra- and inter-network correlations, including correlations with and within the dorsal attention (DAN) and cingulo-opercular task control networks (CON). However, the DMN and frontoparietal task control network were not associated with any significant changes due to ELS. Our results indicate that ELS is associated with changes in functional connectivity in HIV+ individuals, but the mechanism remains unclear.

**Comparison of Diffusion MRI with Axonal Trajectories Near Cortex to Estimate Folding-Related Biases of Tractography-Based Connectivity in the Macaque Brain**

Charles Chen
Mentor: David Van Essen

Diffusion MRI and probabilistic tractography are powerful tools for analyzing long-distance connections within the white matter of the brain, but technical limitations of these methods have become increasingly apparent. One such limitation in current tractography algorithms results in a folding-related bias in apparent connectivity. In particular, there is a tendency for tractography streamlines to preferentially terminate at gyral crowns, compared to sulcal banks and fundi. This leads to folding-dependent discrepancies between the estimates of connectivity in diffusion data versus tracer and histology data. As tracer and histology data are considered to be closer to neuroanatomical ground truth, the origin for the gyral bias lies within the methods by which diffusion fiber orientations are modeled and how tractography streamlines are generated.

Here, the extent of this gyral bias was quantified through comparing diffusion MRI fiber orientations with ground truth neuroanatomy given by an analysis of axonal trajectories from histology. Comparisons made with a structure tensor modelling of histology fiber orientations were validated against manual orientation comparisons, and were used to expedite image analysis. Finally, non-linear registration of histology volumes generated by two-photon microscopy of tissue-cleared samples allows comparison of fiber orientation components in three-dimensions between diffusion MRI and histology. Such observations can potentially be expanded into specific anatomical priors for use in informing diffusion modeling and tractography in white matter close to the cortical gray matter sheet.

**Investigating the Role of Wolbachia Endosymbionts in the Expansion of the F Element in Drosophila Ananassae**

Elizabeth J. Chen
Mentors: Sarah C. R. Elgin

At 4.2 Mb overall, the *Drosophila melanogaster* Muller F element (dot chromosome) is unusual as it exhibits heterochromatic properties, yet its distal 1.3 Mb arm demonstrates gene expression similar to those of the other autosomes. More intriguing is *D. ananassae’s* particularly large F element (~20 Mb), which could offer us a better understanding of how heterochromatic domains are maintained and spread. Previous analysis suggest that one important contributor to the increase in the size of the F element is the lateral gene transfer of the *Wolbachia* genome into *D. ananassae* genome.

Although *Wolbachia* is the most widespread intracellular bacteria in the *Rickettsiales* order, the distribution and number of *Wolbachia* genomic fragments have been unknown. However, by using bioinformatics programs and comparing the *Wolbachia* endosymbionts of *D. ananassae* (wAna) to wMel (the most commonly used reference genome) and wRi (the closest relative to wAna), I classified 30% of the predicted hypothetical proteins (those of unknown function), thus improving our understanding of these integrated fragments’ characteristics. For instance, high densities of Insertion Sequence (IS) transposon remnants (which are associated with chromosomal rearrangements) were found within the Wolbachia genomes, particularly in wAna, suggesting similar types of transposon insertions could play a role in the expansion of the F element.

Utilizing assemblies manually improved, we then investigated wAna genomic scaffolds, which we discovered overlapped with 65 out of 415 unknown repeats, suggesting that many of the unknown repeats are actually derived from *Wolbachia*. We similarly compared the *Wolbachia* distribution within introns to that within intergenic regions, as well identified conserved regions that might impact the expression of the surrounding genes, which all could also contribute to expansion.
MILK AND MATERNAL ENVIRONMENT: 
DIFFERENCES IN MILK sIgA INFECTION RESPONSE IN TIBETAN MOTHERS LIVING AT 
HIGH AND LOW ALTITUDES IN NUBRI, NEPAL 
Meytal Chernoff 
Mentors: Geoff Childs and EA Quinn

Women living in highly pathogenic environments tend to have higher secretory Immunoglobulin-A (sIgA) in their breast milk, possibly providing infants born in these environments with some degree of protection against infectious disease, especially gastrointestinal illness. This has yet to be investigated in populations in a wide range of ecological conditions. Here, we tested for differences in milk sIgA levels between mothers nursing sick and healthy infants living at high and low altitudes in the Nubri Valley, Nepal.

Milk samples were collected from 67 mothers nursing offspring under 2 years of age, living in 6 villages, 3 high (>10,000 ft) and 3 low (<10,000 ft) altitudes. Infants living in low altitude villages had more diarrheal illness (39.1% versus 15.9%; p<0.025); longitudinal research in Nubri also identified higher mortality rates among low altitude infants and children. Milk sIgA was measured with ELISA. Data were analyzed using a linear regression adjusting for maternal parity and infant age.

Mean milk sIgA was 774.6 ± 400 μg/mL. Mothers living at higher altitudes had slightly though not significantly, higher sIgA (785.2 ± 410.9 μg/mL) compared to low altitude mothers (754.3 ± 387.2 μg/mL). Mothers nursing sick infants in the high altitude sample had higher mean sIgA levels than mothers nursing healthy infants in that environment; in the low altitude sample, mothers nursing sick infants had lower mean levels of sIgA than mothers nursing healthy infants. We hypothesize that lower milk sIgA levels may be a contributing factor to increased morbidity and mortality observed in low altitude villages.

CHARACTERIZATION OF THE NOVEL LONG NON-CODING RNA, LCAT45, 
in LUNG, COLON, AND BREAST CANCER 
Danielle Cicka 
Mentor: Christopher Maher

Long noncoding RNAs (lncRNAs) are important in biological regulation and cellular homeostasis. Recently lncRNAs, such as HOTAIR and MALAT1, have been implicated in diseases such as tumorigenesis. The overarching goal of this project is to identify novel, previously uncharacterized lncRNAs in lung cancer as potential biomarkers, as well as understand the mechanism of action of these lncRNAs. Using publicly available RNA-sequencing data from the TCGA, the lab has recently identified 111 novel lncRNAs as potentially important candidates in the progression of lung cancer. One of the top candidates with differential expression in lung cancer is Lung Cancer Associated Transcript 45 (LCAT45). Furthermore, not only was the expression of LCAT45 altered in lung cancer but it was found to be altered in breast cancer and colon cancer in a pan cancer analysis of TCGA data. Through in silico analysis, LCAT45 was also found to be associated with ubiquitin cell cycle processes. As an initial experiment, changes in cellular growth were investigated. Cellular proliferation was decreased when LCAT45 was transiently knocked down with siRNA oligonucleotides in lung cancer. Use of the Click-it EdU assay provided confirmation that cellular proliferation is altered when LCAT45 is knocked down. The Click-it EdU assay was also performed in a colon cancer cell line, which revealed that the mechanism of action of LCAT45 is conserved across cancer types as predicted from the in silico guilt-by-association analysis. Further, inhibiting the proteasome with MG132 and knocking down LCAT45 resulted in a global decrease in total ubiquitination. Knockdown of LCAT45 also suggested that LCAT45 has an impact on several cell cycle proteins, especially those in the G1-S phase transition. This study is the first to identify the expression of LCAT45 in lung, breast, and colon cancer and the beginning of understanding a potentially important oncogene.

Obama the Socialist?: 
AMERICAN MEDIA AND THE PREJUDICE AGAINST SOCIALISM 
Matthew Cleary 
Mentor: Máire A. Murphy

This work is a critical analysis of the use of the term “socialist” in modern American political discourse, with a focus on the term’s place in the ongoing debate over healthcare legislation, namely the Patient Protection and Affordable Care Act. In order to understand what critics and supporters of “Obamacare” actually mean when they argue about the alleged socialist nature of the legislation, I have studied the centuries of confused and ill-defined meanings behind the term “socialist,” from the short-lived Paris Commune to the Soviet Union. Additionally, I offer a brief overview of the history of American opposition to all forms of socialism, which has roots in socialism’s reputation as a foreign ideology inherently incompatible with American individualism, as well as socialist pacifist opposition to American intervention in World War I. Opposition to socialism is the United States is an outlier in Western democracies, many of which have thriving political parties significantly to the left of American Democrats. Examination of this American occurrence offers a lens on
our perception of left-wing politics.

In this research, I investigate a wide spectrum of political discourse – conservative and liberal, mainstream and fringe – and discuss what sort of dialogue is taking place between opposing sides. I also debate whether or not the label of "socialist" actually maintains any legitimacy, and in which scenarios it seems to carry any weight. Ultimately, I speak to the practice of utilizing labels that are loaded with preconceptions to distance discussion from actual issues and shift it into a battle of words.

INVESTIGATING THE ROLE OF CHOLESTEROL DURING MURINE NOROVIRUS INFECTION

Emily Condiff

Mentor: Herbert Virgin

Human norovirus (HNV) is the leading cause of acute non-bacterial epidemic gastroenteritis worldwide and affects millions of people every year. HNV does not grow in tissue culture so murine norovirus (MNV), which does have a culture system, is a useful model to study the lifecycle and virus-host interactions of noroviruses. Previous research in the Virgin lab has shown that the MNV protein NS1/2 interacts with the host protein vesicle associated membrane protein (VAMP)-associated-protein A (Vapa) which is an integral endoplasmic reticulum (ER) membrane protein that is involved in cholesterol homeostasis. In addition, we observed that fluorescently tagged NS1/2 and Vapa co-localized when overexpressed in 293T cells. Because of this, we hypothesize that cholesterol is important for MNV infection, and Vapa mediates this relationship. Through multiple measures, MNV infection does not lead to a change in cholesterol levels in RAW 264.7 cells. Surprisingly, depleting cholesterol by growing cells in lipoprotein depleted serum (LPDS) media showed no effect on cell viability or viral titers. However, Vapa-knockout cells showed increased cell viability during infection, further suggesting that Vapa is important during MNV infection.

RELATIONSHIPS BETWEEN TYPES OF INDEX FUNDS AND PORTFOLIO VALUES

Kaitlyn Crawley

Zachary Feinstein

There are several aspects that contribute to the value of a portfolio invested in the stock market. This research focuses on how the type of index fund and the frequency of rebalancing affects the value of a self-financing portfolio, containing nine stocks from the S&P 500, over time. The primary index funds investigated are a market cap weighted index, an equally weighted index, and an index fund investing in one unit of each stock. The portfolio will be rebalanced over four different time intervals: daily, weekly, monthly, and quarterly, and the calculations for rebalancing use the adjusted close prices for each stock in the portfolio taken from Yahoo Finance. The results show that when rebalanced at the same frequency, the portfolio invested in the equally weighted index generally performs the best, but it is also subject to higher volatility when there are shocks to the economy. Across all rebalancing frequencies, the equally weighted portfolio continues to perform the best, while the values for the market cap weighted and one stock in each index are fairly similar. Additionally, the portfolio invested in the equally weighted index performs best when rebalanced daily; however, the rebalance frequency does not affect the performance of the portfolio in the other two indexes. These conclusions can help investors to optimize the value of their portfolio and decide on a trading strategy.

TUNABLE HELICAL ORIGAMI

Eric Dai

Mentor: Zi Chen, Dartmouth College

Origami, the Japanese art of paper folding, is traditionally viewed as an amusing pastime and medium of artistic expression. However, in recent years, origami has begun to inspire innovations in science and engineering. For example, K. Miura led the study of a paper folding pattern in regards to deployment of solar panels to outer space, resulting in more efficient packing and unpacking of the solar panels into tightly constrained spaces. In this work, we study the geometric and mechanical properties of a twisting origami pattern. The pattern created by the fold exhibits several interesting properties, including rigid foldability, and finely tunable helical coiling, with control over pitch, radius, and handedness of the helix. In addition, the pattern closely mimics the twist buckling patterns shown by thin materials, for example, a mobius strip. In our work, we relate the six parameters of the twisting origami pattern to generate a fully tunable graphical model of the fold. In addition, we demonstrate that the morphogenesis of such folding pattern can be modeled through finite element analysis. We hope our research into the diagonal fold brings insight into the potential scientific and engineering applications of origami and spark further research into how the traditional paper art can be applied as a simple, inexpensive model for complex problems.
INFLUENCES OF INSTRUCTOR BELIEFS, BIASES, AND LANGUAGE
WHILE TEACHING UNDERGRADUATE PHYSICS

Marie Draper
Mentor: Kathryn Mairin Hynes

Growth rates of women’s participation in physics at American universities have remained stagnant for over a decade, even while women have begun outnumbering men in university enrollment. To explore why, this project engages the idea that physics departments act as communities of practice, and physics instructors communicate the community’s cultural expectations through their language when they teach. I emphasize instructors’ impact by comparing the classroom to a laboratory, where the context of an experiment’s set-up influences results. Thus, I argue that instructors should take at least partial responsibility for how they influence students. To investigate natural science instructors’ perceptions about their community and their influence, I designed questionnaires for Washington University in St. Louis (WUSTL) physics, chemistry, and biology instructors. Responses were analyzed quantitatively through basic statistical analysis and qualitatively through examination of short answer writing. Biology instructors, whose student body is 50% women, showed quantitatively more awareness about the impact of gendered language than did physics instructors, whose student body is 10-15% women. Additionally, physics instructors affirmed the importance of language by rejecting the label “feminist” for certain scientific research practices with whose principles they agreed. Assessing the connections between these instructors’ perceptions and the language they use is one step toward encouraging instructors to communicate more inclusively with their students and involve more women in their disciplines.

EMPOWERMENT THROUGH EXPLOITATION? RACIAL-SEXUAL POLITICS AND BODY-POSITIVITY
IN “ANACONDA” AND “ALL ABOUT THAT BASS”

Antonia Drummond
Mentor: Eileen G’Sell

Nicki Minaj’s and Meghan Trainor’s chart topping singles during the summer of 2014, “Anaconda” and “All About That Bass,” each gained attention for their supposed sex- or body-positive messages. At the same time, each song and its corresponding music video play into subtle and pervasive tropes about both black and white female sexuality. Why did “Anaconda” garner praise for its sexual message and “All About That Bass” for its message regarding body image, while both songs confront both female sexuality and body ideals? Largely because of the songs’ respective imagery and sexual content, which both play into and reinforce images of black female “wild” sexuality and white female sexlessness. Minaj and Trainor, both prominently successful women in the male-dominated music industry, reflect a longstanding phenomenon of female performers finding success through exploiting female stereotypes.

EMOTIONAL CLARITY AND EMPATHY:
EXPLORING RELATIONS USING SELF-REPORT AND BEHAVIORAL MEASUREMENTS

Nathaniel Eckland
Mentor: Renee J. Thompson

Emotional clarity is the ability to identify and describe how one feels. Research has found that emotional clarity is related to better psychological functioning, and empathy is related to greater prosocial behavior. Despite the associations with these positive psychological outcomes, psychological research has yet to examine the relation between emotional clarity and empathy. We examined whether emotional clarity and empathy were positively related in a large undergraduate student sample (N=94). To assess empathy, we used a behavioral measure of empathic accuracy, which tests how accurate people are in knowing how other people are feeling. In the current study, we assessed emotional clarity using both self-report and behavioral measures. Participants completed a series of tasks during an individual laboratory session. After completing emotional clarity measures, participants viewed a series of video clips of targets (i.e., participants from a previous study) undergoing a stressful laboratory task involving social evaluation. At the time of the recording, targets reported how they were feeling; and during viewing of the videos, our participants rated how they thought the targets were feeling. Our participants’ ratings of the targets’ feelings were compared to the targets’ self-reported feelings to assess empathic accuracy. Our hypothesis that emotional clarity and empathic accuracy would be positively related was partially supported for the self-report measures. Participants high in emotional clarity showed marginally greater empathic accuracy than participants low in emotional clarity. On the other hand, we did not find that empathic accuracy varied as a function of participants’ emotional clarity measured behaviorally. Our findings represent preliminary support for the importance of emotional clarity, not only for one’s own psychological health, but in the ability to accurately understand others’ feelings and potentially provide appropriate social support.
WHO REALLY GETS TO CLIMB THE LADDER OF SUCCESS? STUDENT RETENTION AT THE UNIVERSITY OF TEXAS AT AUSTIN AND THE FUTURE OF HIGHER EDUCATION ACCESS

Juliet Eisenstein
Mentor: Linda Lindsey

Since 1636, when the first American university was established, access to higher education for students from marginalized races, classes, and genders has been unequal. The University of Texas at Austin (UT) has dealt with these issues very publically in recent years, due to their top ten percent admissions policy and the Abigail Fisher Supreme Court case in 2011. These factors have compelled UT to focus on campus diversity in ways that their peer institutions have not, especially in how it has hurt the university's four-year graduation rates due to poor retention. I analyze UT's largest effort to combat poor retention, the University Leadership Network (ULN), which was established in 2013 to retain students that UT deems the least likely to graduate in four years. After contextualizing issues of diversity and access in the history of U.S. higher education, I employ Vincent Tinto's widely used Student Integration Model (SIM) of retention to provide a theoretical framework through which to analyze ULN. After illustrating how closely the SIM and ULN align in theory, I take my analysis a step further to explore how they match up in practice, through an interview with ULN’s creator and a study of ULN’s Facebook page. As the architect of ULN, Dr. David Laude's words speak strongly to the program's day-to-day operations, while the Facebook page is the most heavily employed means of communication for the ULN cohort. These sources reveal deep contradictions between ULN’s programming and its purpose, through the themes of othering, institutional privilege, community and meritocratic ideals. I conclude that open dialogue and consistent accountability are both required for UT and universities across the country to achieve full retention and advocate for strong policy to aid such efforts.

HERMITIAN SYMPLECTIC SPACES, VON NEUMANN’S EXTENSION THEORY, AND SCATTERING ON QUANTUM GRAPHS

Tyler Ellison
Mentor: Renato Feres

We begin with the definition of a skew-Hermitean form and the corresponding Hermitean symplectic group. We motivate these definitions with a discussion of their relevance to self-adjoint extensions of Hamiltonian operators. In doing so, we introduce the basics of von Neumann's extension theory. Next, we develop the necessary tools from Hermitean symplectic linear algebra to study self-adjoint extensions of Hamiltonian operators on simple one-dimensional regions. We apply these concepts to the scattering problem on non-compact quantum star graphs. Further, we suggest an experiment to determine the particular self-adjoint extension at play. Throughout the discussion, we make explicit note of the appearance of the unitary group $U(n)$, as it parametrizes the set of self-adjoint extensions, the Lagrangian Grassmannian and the possible scattering matrices for a non-compact quantum star graph.

INDIVIDUAL DIFFERENCES IN THREE-PERSON NEGOTIATIONS

Jonathan Finch, Alex Hinch, Batu Otker-en, and Michelle Zhu
Mentor: William Bottom

Research has examined the influence that individual personality and cognitive characteristics have on dyadic negotiation, but not on coalition formation in more complex settings. We investigated the link between outcomes of three-person, asymmetric negotiations by undergraduate students with various Big 5 personality characteristics and “need for cognition.” We hypothesized that “need for cognition” and extraversion will have a positive impact on negotiation outcomes, while agreeableness will have a negative impact. Participants with high need for cognition may be more inclined to develop and implement the strategic planning needed to claim greater value through coalition bargaining, while extraverted participants could form coalitions more easily and thereby perform better. Those with high agreeableness, on the other hand, may be more likely to accept offers proposed to them that may give them far lower value than they might be able to extract otherwise. Past experiments on n-person games have alluded to the suspected impact of personality differences in outcomes but have not tested this in practice. In our study, participants described their individual characteristics across the mentioned
dimensions and were primed with either an article on cooperation or individualism before being asked to engage in a three-person negotiation as one monopolist or as one of two weaker players. To examine negotiation outcomes, we analyzed both the payoffs to individuals in the negotiation as well as information on the perception that subjects had of the negotiation immediately following the negotiation. Our preliminary analysis, subject to modification, shows greater variance in negotiations that were part of a round with many extraverted subjects with high need for cognition. Thus, it could be the combination of intellectual and personality characteristics that determine negotiation success. Implications of our work include evaluating other individual qualities with closer magnification to determine bargaining outcomes. The results also may highlight the power of social pressures for cooperation.

**Understanding Malagasy Women’s Preferences for Reproductive Health Care**

Mackenzie Findlay  
Mentor: Carolyn Sargent

In rural Madagascar, women seeking reproductive health care may have the option of consulting their traditional birth attendant, local midwife or biomedical physician. In those cases in which a woman does have a choice, our understandings of how she makes that decision is limited. In this research, I investigate women’s perspectives on the health care options available to them and seek to understand the factors that influence their decision to choose a particular type of care. I seek not to validate biomedical care and critique traditional practices; rather, I seek to understand the interplay between cultural traditions and the health care system, as well as the barriers, whether physical, cultural, or spiritual, that women may face in seeking their preferred type of care. I conducted 23 interviews with women in the community as well as doctors, midwives, traditional birth attendants, and local leaders in Mahabo, Madagascar in 2014. The research revealed that women in Mahabo-Mananivo seek a combination of type of reproductive care: they value the clinic and attend free monthly prenatal appointments, but primarily deliver their children at home due to significant financial, physical and spiritual barriers. Through the lens of the socio-ecological model, I suggest several means to improving childbirth outcomes in this community from a culturally informed perspective: 1) teaching hygiene practices, 2) increasing engagement and building trust between community members and the doctor, 3) improving transportation and accessibility with an ATV, 4) community outreach through skits and dialogue, and 5) building a midwifery clinic to bridge the gap between the community and biomedicine.

**Composition of Bladder Basement Membranes and Structural Alterations Resulting from Infection with Uropathogenic E. coli**

Jake Foote  
Mentor: Jeffrey Miner

Extracellular matrix, basement membrane proteins, and some cellular proteins present in the bladder were characterized using isoform-specific antibodies. Staining for these proteins revealed their localization within the bladder tissues, including the urothelium, urothelial basement membrane (UBM), lamina propria, smooth muscle, and the serosal basement membrane. The localization of Laminins α1, α2, α3, α5, β1, γ1, γ2; Collagen IV α1, α2, α3, α4, α5; fibronectin, nidogen, agrin, perlecan; keratin-5, -8, desmin, PECAM, the macrophage marker F4/80, and the neutrophil marker GR1 were all characterized in both healthy and infected bladders.

Over the course of infection with Uropathogenic *E. coli* (UPEC), neutrophils are recruited to the urothelium by resident macrophage populations. Passage into the urothelium requires passage through the UBM. However, the UBM normally forms a meshwork that serves as a barrier through which cells cannot easily pass. We hypothesized that breaks in the UBM evident in infected bladders are the result of the passage of neutrophils to the site of infection in the urothelium. A greater number of UBM breaks, as well as a greater degree of GR1 (neutrophil) staining in the urothelium were evident in the infected bladders in comparison to an uninfected control. Neutrophil staining was assessed qualitatively while breaks were quantified and standardized over the UBM length in question. Thus, it is likely that the breaks evident in the UBM are the product of the passage of neutrophils recruited by the resident macrophages, from the lamina propria to the urothelium.

**PASMO in the Postpartum: Are There Differences in Cortisol and Nutrients of the Milk from Filipino Women with and without a Culturally Bound Syndrome Associated with Postpartum Stress?**

Christian Freeman  
Mentor: E.A. Quinn

Many women report considerable stress during the postpartum period and frequently report concerns about psychosocial stress altering milk composition. All adults can experience a culturally bound syndrome known as *pasmo*, which may be a culturally appropriate way
of expressing postpartum depression when occurring in the postpartum period. Milk samples were collected using standard protocols and frozen immediately. We investigated the association between pasmo and human milk cortisol levels in 104 women from Cebu, Philippines. Milk samples were analyzed using a modified commercially available EIA kit. ANOVA was used to test for differences in milk cortisol and nutrients in women with and without pasmo. For women with pasmo, milk cortisol averaged 0.701 ± 0.437 μg/dL compared to 0.724 ± 0.581 μg/dL for women without (p=0.41); these differences were not significant. Similar analyses were conducted for milk fat, sugars, protein and energy. We found no differences in milk nutrients by maternal pasmo status. These findings show that the culturally bound syndrome of pasmo, as a condition associated with perceived maternal stress, does not impact milk cortisol levels or nutrients. Previous research has shown that infant temperament can be affected when exposed to biologically active components in milk (such as cortisol). These findings are important because this is the first clear evidence showing no effect on perceived stress and cortisol in milk. While pasmo is not postpartum depression as PPD is understood in the United States, these findings do suggest that conditions associated with perceived maternal stress may not influence milk cortisol or nutrients.

**A Novel GABAergic Projection Links Central Amygdala to Frontal Cortex and Mediates Reward Behaviors**

Samuel C. Funderburk  
Mentor: Michael R. Bruchas

The neural circuitry underlying mammalian reward behaviors comprises several distinct nuclei throughout the brain. Previous research has indicated that inhibiting the infra-limbic area of the frontal cortex is rewarding to the animal, while activating the central amygdala during reward presentation increases future preference for that reward. Using viral vector-mediated, cell-type specific viral fluorescence tracing in transgenic mice, we identified a GABAergic projection originating in the central amygdala (CeA) that terminates in the infra-limbic area of the frontal cortex. Follow-up experiments to optogenetically activate this circuit in awake, behaving animals produced reward-like behaviors. We hypothesize that activity in these cells inhibits the infra-limbic cortex, and are in the process of in vivo electrophysiological recordings to support this claim. This long-range GABAergic interaction between amygdala and frontal cortex adds a new dimension to the complex regulation of stress- and reward-related behaviors and provides a potential mechanism for the emotional regulation of cognition.

**A Purine Monophosphatase Is a Second Regulator of the Methylerythritol Phosphate (MEP) Pathway in P. falciparum Malaria**

Aakash Y. Gandhi  
Mentor: Audrey R. Odom

The methylerythritol phosphate (MEP) pathway for isoprenoid biosynthesis, used by apicom-plexan protozoa like *P. falciparum*, is a promising target for antimalarials. Previously, the Odom Lab identified that a sugar phosphatase (PfHA D1) is a novel regulator of isoprenoid biosynthesis in malaria, and appears to function by limiting the availability of phosphorylated sugar pre-cursors to the MEP pathway. Here, we report the genetic and biochemical characterization of a highly related locus loci to PfHA D1, herein referred to as PfHA D2. In laboratory malaria strains, loss-of-function mutations at the PfHA D2 locus were found to be associated with increased resistance to fosmidomycin, a specific inhibitor of the MEP pathway. Expression of PfHA D2 in these strains were found to complement fosmidomycin sensitivity, strongly suggesting that PfHA D2 is a negative regulator of the MEP pathway in malaria. To begin studying the biochemical function of PfHA D2, we used a 6His-recombinant expression system to purify functional enzyme. Strikingly, PfHA D2 was found to dephosphorylate nucleotides, with highest catalytic efficiency towards purine monophosphates (AMP, GMP). From these preliminary results, we predict that PfHA D2 regulates the MEP pathway by dephosphorylating purine effectors of upstream glycolytic enzymes. In future experiments, we will use homology modeling to determine the structural basis for the distinct biochemical functions of PfHA D1 and PfHA D2, and apply in vitro mutagenesis strategies to confirm predictions experimentally.

**Total Synthesis of Cochlearol B**

Jackson Gartman  
Mentor: Vladimir Birman

(-)-Cochlearol B, a meroterpenoid with a novel pentacyclic structure, has shown antifibrotic effects in the kidney in a dosage-dependent manner via disruption of TGF-β phosphorylation of Smad2 and Smad3. Discovered by Man Dou and colleagues, the molecule was isolated in minute quantities from a fungus found in tropical regions, *Ganoderma cochlear*. Here we propose a concise synthesis for Cochlearol B that may produce higher yields compared to isolation from its natural source. Currently, the first 3 steps are in progress.
OBSTACLE AVOIDANCE USING PAIRED SENSORS: ULTRASONIC TRANSUDER AND KINECT CAMERA

Dagmawi Gebreselasse and Stephen Gower
Mentors: Arye Nehorai and Ed Richter

In obstacle avoidance, it is critical to optimize the way in which the robot “sees” the world. In this case, we sought to pair two sensors, the Ultrasonic Transducer and the Kinect camera, for use in basic obstacle avoidance. The pairing of the two sensors theoretically allows them to complement each other. The Kinect camera for instance, has a minimum depth of 0.5m, while the Ultrasonic Transducer has a minimum range of 0.03m. On the other hand, the Kinect has much better resolution and allows for 3D mapping of the surroundings. The two sensors offer a beneficial pairing and for that reason we aimed to use the two in tandem and allow for the robot to better navigate its surroundings. To accomplish this we used LabVIEW 2013 as well as some MATLAB script to interface with and pull readings from the Kinect camera. The robot used was a standard NI-sbRIO robot. In the first phase of the project we looked at some existing code using just the Ultrasonic Transducer and attempted to replicate it in a simpler fashion. Then we looked into and developed our own strategy to use the Kinect camera to do the same basic avoidance. From there we brought the two together to accomplish very basic avoidance to have the robot move between two stationary walls into a gap between the two. We are attempting to prove that the two could be efficiently paired together to perform basic avoidance and to optimize the system for more complex avoidance.

EXPLORATION OF DONOR GIVING PATTERNS AND OPTIMAL SOLICITATION STRATEGIES

Ryan Geczi, Matt Puzder, Ruicong Yan, Alexander Zaiken
Mentor: Seethu Seetharaman

Charitable donations stem from four major sources: individuals, corporations, bequests, and charitable foundations. Growth in monetary charitable gifts has exploded in recent decades, more than doubling the growth of the S&P 500 (List 2011). Typically focusing on individual giving, traditional predictive metrics used by fundraising campaigns emphasize the importance of the overall contribution rate (as a percentage of solicitations) and cumulative individual contribution levels. Separation of “cold-list” and “warm-list” donors typically postulates a larger economic value of a warm-list donor due to both a greater likelihood to contribute and a larger donation amount. In allocating outreach budgets, fundraising campaigns face a cost trade-off between rekindling a donor on the warm-list and canvassing a potential new donor on the cold-list. Our research explores the returns on marginal solicitations and the effect of a recent large donation on subsequent probability of donating. We examine a dataset featuring the donation habits of individuals and the demographics associated with the postal (ZIP) code that the donor lives in. Using LPM models of past donation patterns and demographic controls, we predict the likelihood of a future contribution. Results indicate that a greater number of cumulative solicitations significantly improves odds of donating up to a certain threshold, after which the impact of marginal solicitations declines sharply. We also identify a “cooling” period between solicitations to maximize the aggregate contribution made across all solicitations for an individual. These effects are observed to be consistent across four solicitation types, holding constant regional differences between individuals. Implications of these results can be used by fundraising campaigns to better plan outreach strategies to maximize cumulative returns and better allocate spending across warm- and cold-list donors. Based on differing costs of reaching new and recurring donors, these findings aid in outreach trade-offs given fixed budget constraints.

Mathias Gesser
See Matthew Ayanian


Chris Gibson
Mentor: Jon Rogowski

To what degree were nineteenth-century legislators rewarded or punished for their behavior in office? Despite the prominence of nineteenth-century legislative and electoral reforms in scholarship on legislative behavior and electoral accountability, existing research provides little direct evidence for how well voters held members of Congress responsible for their actions. This paper studies the role of distributive politics between 1876 and 1896, specifically examining the relationship between legislators’ receipt of federal spending and electoral outcomes. We introduce an original data set of the distribution of federal post offices at the county level to characterize the
allocation of federal resources. Both Gilded Age contemporaries and historians frequently point to the expansion of the post office during this time period as the most important development in expanding the reach of the national government into local communities. We find that the provision of post offices significantly boosted vote shares of incumbents who won by a narrow margin in their previous election, and upon introduction of the Australian ballot. This latter finding suggests that the Australian ballot brought about a new period of individual electoral accountability, as voters could now distinguish a politician from his party and reward him on his own beliefs, merits, and services. Our results have significant implications for evaluating the effects of electoral institutions and for characterizing legislators’ incentives to engage in state-building activities.

**FOR (Y)OUR BEST INTEREST: THE MINIMUM DRAFT ELIGIBILITY AGE REQUIREMENT AND THE CONFLICTING GOAL OF PROFITABILITY IN THE NBA**

Lisa Ann Gosine  
Mentors: Heidi Kolk and Maire Murphy

Since the start of professional competitive sports, there has been a significant change in the perception of what it means to be a professional athlete. In the 1900s, professional athletes often had to work during the off-season to support themselves because their salaries were so small. However, a rise in sponsorship, television deals, and other forms of income for the sports industry has led to increased interest in becoming a professional athlete, along with a positive surge in the cultural perception of athletes. For many young athletes, the idea of playing a sport professionally presents the opportunity to make a significant amount of money in a relatively short period of time. Moving forward, the National Basketball Association (NBA) has shown interest in raising the minimum age for draft eligibility from 19 years and at least one year out of high school to 20 years and at least two years out of high school. The league has received resistance on this topic from athletes who view this as unfair, while the NBA and the National Collegiate Athletic Association (NCAA) have expressed sentiments of concern for young players and their ability to play at the professional level with little to no collegiate or post-high school experience.

As you look closer at the parties involved in this situation, the relationship between the athletes’ success and the subsequent financial success of the NBA or the NCAA becomes clear. This raises the question of who truly benefits from raising the minimum age for draft eligibility, the league and the NCAA or the athletes. Throughout a series of articles, I evaluate different perspectives in this debate and examine this question in greater detail.

Stephen Gower  
See Dagmawi Gebreselasse

**VESICULAR TRAFFICKING IN TETRAHYMENA:**  
**STUDY OF TWO VPS4 GENES AND A CALCINEURIN REGULATORY SUBUNIT**

Jordan Grainger, Rachel Grant, and Greg Harrison  
Mentor: Douglas Chalker

Vesicular trafficking has central importance to the organization and function of eukaryotic cells, allowing for communication between distant cellular compartments, and interactions with the extracellular environment through endo- and exocytosis. The single-celled eukaryotic ciliate *Tetrahymena thermophila* has a sophisticated array of intracellular trafficking processes, including highly developed secretory granule systems that are absent in other unicellular organisms, making it an ideal model system to study these processes. Complex cellular signals target vesicles to specific organelles, or mediate exocytotic and endocytotic processes. Calcineurin, a highly conserved protein involved in many cellular signaling processes, may also have a role in vesicle-related signaling. VPS4 proteins, also highly conserved, have been implicated in vesicle formation in yeast, and may have similar roles in *Tetrahymena*. To elucidate the role of VPS4 proteins and calcineurin in *Tetrahymena*, we created YFP-fusion constructs of two VPS4 genes, VPS4A and VPS4B, and a putative calcineurin regulatory subunit, CNBL1. Visualization of the localization of our fusion proteins revealed that CNBL1 localizes to vesicles in all three stages of *Tetrahymena* development: growth, starvation and conjugation. VPS4A localizes to the cytosol and oral apparatus in growing cells, and the parental macronucleus in conjugating cells. VPS4B localizes nearly everywhere in growing cells, diffusely present in both the cytosol and macronucleus. These localization patterns lead us to conclude that CNBL1 is trafficked through the cell and may be involved in the signaling-mediated regulation of these processes; VPS4A and VPS4B may have a critical role in vesicular trafficking, and VPS4A may have an additional role in programmed nuclear death. Further study of these proteins will provide insight into vesicle formation and function in *Tetrahymena* and other organisms.
Development of intricate retinal structure requires precise control of gene expression through the coordinated action of cell type-specific transcription factors and general epigenetic regulators. One epigenetic factor, the histone methyltransferase MLL1, essential for neurogenesis in the adult brain, is also expressed uniformly in the mouse retina, and is potentially regulated by the retina-specific transcription factor CRX. This leads to the hypothesis that MLL1 has an essential role in retinal neurogenesis. To test this hypothesis, we conditionally knocked out Mll1 from early retinal progenitor cells. The Mll1 conditional knock-out (Mll1
cKO
) mice had severely impaired visual function and thinner retinas. The thinner retinas in Mll1
cKO
 mice may be due to proliferation defects; Mll1
cKO
 developing retinas had fewer proliferative cells as well as S-phase entry and M-phase progression defects. However, there was no increase in apoptosis. In addition to proliferation and cell cycle defects, Mll1
cKO
 retinas had fewer neuronal cells but normal numbers of Muller glial cells compared to the control mice. Experiments tracking birth of late-born cells showed that the proportion of Muller glial cells in the late-born cell population was significantly increased in Mll1
cKO
 retinas compared with controls, suggesting that MLL1 promotes neurogenesis over gliogenesis. Mll1
cKO
 retinas also had significantly fewer horizontal cells by postnatal day 14 (P14), but showed normal horizontal cell numbers at P7, suggesting a role of MLL1 in horizontal cell terminal differentiation. Together, our results suggest that MLL1 is essential for retinal development by regulating both cell cycles and cell fate specification, two closely linked aspects of retinal neurogenesis.

**A “Prime” Example: Female Street Art and the Cultural Hack**

*Zoe Grieze*

Mentor: Eileen G’Sell

Creating unwelcome art is a powerful act. Street art, the injection of artwork into the infrastructure of a city, is an example of unwelcome art. Art created by women, especially art refusing to conform to current cultural expectations of the female form, is another. If the social systems we inhabit are codes that shape us, unwelcome or uninvited artworks are hacks of those codes. These disruptions rewire our relationships to others and transform our interactions with our environments. In this investigation of the cultural hack’s capacity to reclaim and modify dialogue, I specifically examine Prime by Faring Purth, a work of street art located in the Cherokee neighborhood of St. Louis. During Prime’s installation, it became the subject of local controversy, largely due to the history of its location and its portrayal of the female body. I analyze the social media manifestations of the dispute, as well as the conditions of the neighborhood of Cherokee. Placing the controversy in the context of history, I explore examples of female street artists, public art portraying the female body, and art in which female artists portray the female body. Last, I examine what makes Faring’s public art successful as a hack, as well as the potential of public art to spur the conversations necessary to improve urban living conditions.

**The C-terminal Linker of FtsZ Acts as an Intrinsically Disordered Peptide during Cell Division in Bacillus subtilis**

*Steven Grigsby*

Mentor: Petra Anne Levin

The bacterial tubulin homologue FtsZ polymerizes in vitro in a GTP-dependent manner to form long, single stranded filaments. In cells, these filaments assemble at the nascent division site, interacting laterally to form the contractile Z-ring, which serves as a scaffold for the rest of the division machinery and constricts at the leading edge of the invaginating septum during cytokinesis. FtsZ consists of three primary domains: the N-terminal globular core consisting of 315 residues that contains the GTP-binding site, a variable and flexible C-terminal linker (CTL) consisting of 50 residues, and a conserved region at the C-terminus consisting of 17 residues known as the grappling-hook peptide (GHP) containing binding sites for modulatory proteins. The CTL was recently shown to behave as a flexible intrinsically disordered peptide (IDP) that is required for FtsZ assembly in vitro and function in vivo. To gain insight into the role of the CTL in FtsZ assembly, I am testing the structural parameters that define a functional CTL. Using computational predictions developed by the Pappu lab, we have generated six CTL variants in the context of native FtsZ: CTLV1-CTLV6. By changing the order and patterning of charged residues in the IDP sequence, these variants undertake conformations ranging from linear to globular or hairpin-like structures. To characterize the impact of these variants on Z-ring formation in vivo, I am assessing their impact on Z-ring formation, growth, and division in the model bacterium Bacillus subtilis. Results suggest a range of CTL conformations is tolerated, but extremely flexible or rigid linkers can lead to instability and aberrant FtsZ assembly in vivo. Experiments performed with synthetic CTL linkers yield results that support this conclusion.
Moving in the Right Direction: Cortical Structural Proteins in *Tetrahymena thermophila*

Steven Grigsby, Vita Jaspan, Hunter Malasky, and John Wieser
Mentor: Doug Chalker

The cortical structure of a cell is essential for motility, feeding, as well as many other processes. This highly organized portion of the cell includes cilia, basal bodies, kinetodesmal fibers, and oral apparatus proteins. At this point, the cortical structure of cells is poorly characterized even though it has many important implications. For example, in humans, defects in some of these structures can be very detrimental to human health, leading to disease. *Tetrahymena thermophila* provides a particularly well-suited model organism for studying cortical structures since its structure is highly organized and easy to manipulate. In this study, we aim to characterize the localization of multiple *Tetrahymena* structural proteins including Kinetodesmal Fiber Protein 3 (Kdf3), Basal Body Assembly Protein 1 (BBAP1), Tetrin A (TTNA), and Membrane Occupation and Recognition Nexus Protein 36 (MRNO36). We generated YFP-fusion proteins, and examined their location in *Tetrahymena*. The localization showed that each protein was expressed in various cortical structures including the basal bodies and surrounding area (BBAP1, MRNO36), kinetodesmal fibers (Kdf3), and oral apparatus (TTNA). By co-localizing these proteins with each other, as well as with other proteins with known localizations, we can further our knowledge of the cortical structure's complexity.

The Direct and Indirect Effects of Fire Differentially Affect Germination of Two Invasive Species, *Lonicera maackii* and *Ailanthus altissima*

Shannon Guthrie

Ecosystems that are perturbed from their natural disturbance regimes have been shown to be more vulnerable to the establishment and dominance of exotic plant species. As such, restoration of these ecosystems typically begins with reintroducing natural disturbances, such as fire or floods. In particular, managing ecosystems by reintroducing fire is common in North America, and many land managers initiate prescribed fires with the goal of reducing the abundance of invasive exotic plant species. The responses of many native species to fire are well known; fire-adapted species respond directly (heat and smoke cue germination) and indirectly (post-fire environment benefits seedling survivorship and growth) to fire. However, the direct and indirect effects of fire have never been systematically assessed for many exotic plant species. I tested the direct and indirect effects of fire on two woody invasive species, *Ailanthus altissima* and *Lonicera maackii*. To test the direct effects of fire, I exposed seeds to varying levels of heat and smoke in a lab setting and compared their germination rates in the greenhouse. In addition, I placed seeds on the soil surface or belowground during a prescribed fire in the field and compared their germination rates in the greenhouse. I tested the indirect effects of fire by comparing seedling recruitment in burned and unburned woodland plots. I found that neither *A. altissima* or *L. maackii* have germination cues associated with fire. However, both species have greater seedling recruitment in burned as compared to unburned areas. Although seeds of these invasive species are not specifically adapted to fire, they still benefit from the post-fire environment and will pose a challenge in restoration of fire-maintained ecosystems.

Disentangling the Effect of Species Traits and Soil Chemistry on Decomposition in a Temperate Forest Ecosystem

Kate Harline
Mentors: Scott A. Mangan and Jonathan A. Myers

Globally, forests play an important role in the cycling of carbon, with the carbon balance of a forest determined by the uptake of carbon via tree growth and by the release of carbon through decomposition. Although many studies have examined tree growth within forests, less is known about how decomposition varies across the same landscapes. Decomposition rates in forests are primarily influenced by both soil conditions (nutrients, microbes) and the functional traits of tree species (physical and chemical properties of leaves and wood). However, the relative importance of soil resources and functional traits as determinants of decomposition rates remains unclear. Here, we compared how soil nutrients and a functional trait related to carbon acquisition (specific leaf area [SLA]) influence decomposition rates in a temperate deciduous forest at the Tyson Research Center, Missouri. To measure decomposition rates, we distributed 153 litterbags across four habitat types (east-slopes, west-slopes, ridges, valleys) and calculated the mass-loss rate of each litter bag over 12 months. We hypothesized decomposition rates would be jointly influenced by soils conditions and the functional traits of tree communities.

We found that decomposition was higher in valley habitats with higher soil-resource availability and in local communities where tree species had higher SLA. However, when we jointly examined the influence of soils and trees, we found that variation in decomposition rates was driven primarily by variation in SLA among local tree communities and that variation in soil resources had no influence on decomposition rates. Our results suggest that decomposition rates are more strongly influenced by changes in the functional traits of...
trees than changes in soil nutrients across landscapes. Moreover, our results suggest that changes in tree species composition, in response to local disturbances such as drought or due to climate change, may influence the carbon balance of temperate deciduous forests.

Greg Harrison  
See Jordan Grainger

Alex Hinch  
See Jonathan Finch

**SHOW ME EQUITY:**  
**BARRIERS TO ENROLLMENT IN THE HEALTH INSURANCE MARKETPLACE FOR BLACK MISSOURIANS DURING THE FIRST OPEN ENROLLMENT PERIOD**

Rachel Hoffman  
Mentor: Bradley Stoner

As one of the populations with the highest uninsured rate, African-American Missourians stood to benefit greatly from the Affordable Care Act (ACA) in regard to health status and access to health care. However, there was a gap in African-American enrollment in Missouri during the first ACA Open Enrollment Period, when compared with other groups. This study seeks to identify and examine barriers African-American Missourians faced when enrolling in the Health Insurance Marketplace during the first ACA Open Enrollment period. Using an anthropological perspective, this work seeks to answer the questions: What factors deterred African-American Missourians from enrolling in the Health Care Marketplace during the first Open Enrollment Period? What lessons learned during the first Open Enrollment Period can help stakeholders better engage African-American Missourians in the future? To identify these barriers, key informants, who were selected based on their role in the rollout and functioning of Missouri’s Health Insurance Marketplace, were interviewed. Data and published reports were used to support the findings. The main barriers identified included health insurance literacy, lack of targeted outreach to African Americans, outreach structure, and affordability. Confounding factors included disparities in African-American health and health care accessibility, misconceptions and stereotypes about the African-American population, lack of trust in government and the American medical system, and systemic racism. These findings can help inform future policymakers and make implementation of, and outreach for, the Affordable Care Act more racially equitable in order to better serve African-American populations in Missouri.

**DISSECTING THE ROLE OF FBXW7 IN MYELINATING GLIAL CELL DEVELOPMENT**

Melanie Holmgren  
Mentor: Kelly Monk

Myelin is a lipid-rich membrane surrounding axons in the vertebrate nervous system; it is responsible for maintaining efficient transmission of action potentials, as well as for protecting axons. Schwann cells in the peripheral nervous system (PNS) and oligodendrocytes in the central nervous system (CNS) form the myelin sheath by iteratively wrapping their plasma membrane around axon segments. Although disruption of the myelin sheath can cause debilitating symptoms in neurological diseases such as multiple sclerosis, the molecular mechanisms of myelination are currently poorly understood. A better understanding of these processes would help us develop therapies to prevent demyelination and/or enhance remyelination in cases of injury or disease.

Therefore, we sought to discover novel regulators of myelination by conducting a forward genetic screen in zebrafish. Through this screen, we identified at least 31 mutations affecting the development of myelinating glia. One such mutation, stl64, produced a dramatic overexpression of *myelin basic protein* (*mbp*) in the CNS. Using whole genome sequencing we identified *stl64* as a nonsense mutation in the gene *fbxw7*. *Fbxw7* is a ubiquitin ligase that is responsible for targeting proteins for degradation. Although there is still extensive work to be done in order to fully understand the role of Fbxw7 in myelination, we have found that the *stl64* mutation results in an increased number of oligodendrocytes and increased myelin thickness. Using *in situ* hybridization, I have shown that the expression of several transcription factors critical in myelination is misregulated in *stl64* mutants. These data suggest that Fbxw7 may be essential for maintaining homeostasis of gene transcription and protein concentrations during myelinating glial development.
MODULATION OF LOCUS COERULEUS CIRCUITRY IN STRESS-INDUCED ANXIETY

Daniel Hong
Mentor: Michael Bruchas

The locus coeruleus (LC) is the primary source of norepinephrine in the forebrain. Knowledge of the afferent inputs into the LC is limited and difficult to ascertain, given the complex interactions of the neurons and their neurotransmitters. We used modern viral tracing methods to overcome these limitations. Utilizing viruses such as the adenoassociated viruses, we were able to uncover projections between the LC and other brain structures such as the central nucleus of the amygdala (CeA). The other main focus of our work was to determine if stress-induced anxiety is mediated through specific receptor activation in the LC. Optogenetics and viral targeting allowed us to activate and antagonize such receptors in the LC and significant stress-related effects on the mouse's behavior were observed. Direct stimulation and activation of these neurons via the corticotropin-releasing hormone receptor (CRHR1) promoted anxiogenic behavior while inhibition of the LC neurons drives anxiolytic behavior. These results present new and compelling evidence that the LC plays an integral role in the regulation of the behavioral response to stress.

VERIFYING LAWS: A NORMATIVE CONCEPTION OF CONSTITUTIONAL PREVIEW

Michael Hoosier
Mentor: Ian MacMullen

In Verifying Laws, I start with the observation that traditional courts of constitutional review (i.e. institutions which verify a law’s constitutionality only after its promulgation) fail to sufficiently protect citizens from government rights violations. I contend that in order to be normatively legitimate a government must make good-faith efforts to justify its coercive decisions to those coerced. In failing to do all it can to ensure protect citizens’ rights from itself, a government fails to satisfy these conditions of legitimacy. As a remedy to this problem, I start with the presumption that a court of constitutional preview (i.e. requiring a law’s constitutionality to be validated before it can be promulgated) would minimize such violations – a necessary step for enhancing the legitimacy of a state. This project theorizes and considers if preview could be as beneficial in practice as it is in principle.

Using observations from a global survey, I put forward a list of criteria against which a constitutional court should be evaluated. Using these dimensions, I consider several institutional options, eventually settling on the following prototype: an elected court of judges limited in term, whose rhetoric is limited to constitutional philosophy, and whose decisions can block the passage of legislation. This body would be called “the Council of Censors.” After considering several objections to this prototype, I recognize that democratic and utilitarian considerations demand a way to overrule the Council’s power in cases of supreme emergency. To institutionalize this exception, I propose a legislative override procedure that is only applicable if the legislature first designates the proposed law as an emergency response. This procedure mediates a tension between moral and practical considerations, striking a necessary balance between the rights of individual citizens and the public good.

CINGULATE VOLUME AND RISK FOR PATHOLOGY IN HEALTHY CHILDREN

Kaitlin Huennenekens
Mentor: Deanna Barch

Despite the diverse etiologies of different psychiatric disorders, there is evidence for common alternations in neural structure across psychopathology types. In particular, previous work has shown that decreases in anterior cingulate cortex (ACC) gray matter are evident across many forms of psychopathology. This decrease in gray matter may reflect ‘toxic’ effects of experienced pathology and/or related stress. However, the fact that common structural changes are seen, despite varying etiologies, may suggest a common source of risk for psychopathology generally rather than effects of psychopathology. To investigate this question, the current study examines how ACC volume in healthy children is predicted by risk for psychopathology, defined by maternal psychopathology. We found that the number of maternal psychiatric diagnoses (sum of depression, anxiety, and substance use disorders) predicted larger ACC volumes in the child. This relationship was not explained by the mother’s current depressive symptom level, number of stressful life events experienced by the child, or the child’s depressive symptom level. This suggests that enlarged ACC volume in healthy children likely reflects a risk factor for psychopathology, rather than elevated severity of depressive symptoms or stressful life events. Future studies are needed to examine factors mediating the transition between enlarged ACC volumes seen here with elevated psychopathology risk, to reduced ACC volumes associated with psychopathology diagnosis in the adult literature.
**ISOLATION, CHARACTERIZATION, AND GENOMIC ANALYSIS OF MYCOBACTERIOPHAGE CLARICE**

Denton Hui, Brandon Lau, Caroline Nore, and Monica Perumattam

Mentors: Sarah Elgin, Kathy Hafer and Christopher Shaffer

Mycobacteriophage Clarice is a newly isolated, sequenced, and annotated phage that can infect *Mycobacterium smegmatis*. Phage Clarice was isolated from a moist soil sample collected in front a restaurant in O’Fallon, Illinois, an area that has not often been used as a sampling site for Washington University’s phage hunting initiative. Clarice is a Cluster C phage with an isometric head and a short, stubby tail, and produces small, clear plaques, suggesting it is virulent. The total Clarice genome is 154,450 base pairs in length. Due to this large size, the genome was divided amongst two groups; presented here is an analysis of the first half of the genome (1-80,500). Overall, 132 genes, all transcribed in the forward direction, were annotated through bioinformatics analysis programs such as DNA Master, BLAST, Phamator, and GBrowse. The function of 3 of the genes was determined through comparative analysis of other phage proteins. Phamator was used to generate a map of our gene calls and also offered comparisons to 2 other phages, from which we were able to obtain information about gene function and identify genes that code for proteins such as the histidine triad domain, a phosphoesterase, the tail assembly chaperone, and the tarpemasure protein. Further analysis will be necessary to assign more gene functions and delve further into an investigation surrounding Clarice’s evolutionary lineage.

**“MAKE HIM KNOW WHO YOU ARE”: AGENCY AND VICTIMIZATION IN THE LIVES OF TRAFFICKED WOMEN**

Lily Jacobi

Mentor: Bret Gustafson

I am interested in the negotiation of migration, trafficking, and the pursuit of recognition and valuation by the disenfranchised. This project is based on semi-structured interviews with seventeen Nigerian women working in prostitution, key informant interviews with practitioners working in the field, and participant observation at a resource center for foreign women in prostitution. I engage with anthropologist Sherry Ortner’s theory of agency and ‘serious games’ as one means to think about the way that trafficked women lived in restrictive personal and political circumstances—in, if you will, the undertheorized space between agency and victimization. I argue that Nigerian women practiced agency in pursuit of projects, processing their experiences through religious discourses of empowerment and feeding the remittance economy and establishing a transformative site of gendered social change in their communities and on the margins of the global economic system. I then consider the larger, structural project of the Danish state and its anti-trafficking apparatus; namely, the prevention of the immigration of trafficked persons and the perception that being trafficked is a viable method of immigration. I ultimately argue that an articulate narrative of victimization, strategically modified to meet the raced and gendered expectations of the Danish state, was a tool by which trafficked women made demands and accessed the services guaranteed by the state. Moreover, I maintain that this complication of the polarized feminist debate on victimization offers scholars an additional avenue in which to theorize on spaces characterized by the conflict between agency and victimization and to recognize the complexity of individual experiences. I contend that victimhood, far from being a totalizing state of subjection, offers its own possibilities of empowerment and generation. For many women, victimhood provided a vocabulary and a way of understanding their experiences that helped to process and make meaningful sense of the trauma and violence in their lives.

**QUANTUM TRAJECTORY DYNAMICS OF A SUPERCONDUCTING QUBIT UNDER MEASUREMENT AND UNITARY EVOLUTION**

Arian Jadbabaie

Mentor: Kater Murch

Superconducting quantum circuits represent a versatile and robust platform for experimental inquiries in quantum mechanics. By dispersively coupling a transmon circuit to a 3D Aluminum waveguide cavity, we are able to use the coherent modes of electromagnetic radiation in the cavity as pointer states to indirectly measure the state of the circuit. Reducing thermal excitations with a dilution refrigerator allows us to treat the circuit as a qubit, restricting our analysis to the manifold of states on the Bloch sphere. By pumping the cavity with photons near or at qubit resonance, we may rotate the qubit state and induce Rabi oscillations. Weakly probing the cavity with resonant radiation allows us to recover partial information about the quantum state from the quadrature values of the reflected signals. If we monitor the fluctuations of the environment, we may track the measurement backaction on the quantum state. We use a stochastic master equation to propagate the density matrix of a single qubit, using a Bayesian update process conditioned on the weak measurement outcome. These quantum trajectories have been verified, using projective measurements, to accurately encode information about the quantum state, providing us with a glimpse into purely quantum dynamics as the qubit traverses Hilbert space. I examine
quantum trajectories for fixed length and varied measurement strength. By examining the qubit phase space, we may understand the relationship between trajectory dynamics and location on the Bloch sphere. This allows us to characterize phenomena such as the quantum Zeno effect, quantum jumps, and measurement purification. The ability to track and analyze the individual motion of quantum states provides novel insight into state dynamics, allows for better manipulation of qubits, and is an excellent platform for investigations into quantum mechanical foundations.

**Strategies for Effective Learning in College Students with ADHD**

Aliza Jaffe  
Mentor: Mark McDaniel

Attention-Deficit/Hyperactivity Disorder is one of the most prevalent mental health disorders in the US, affecting 3-5% of the population. One of the major corollaries to this disorder that has been heavily studied is a decrease in academic performance. Most of the literature on ADHD and academic performance focuses on students in primary and secondary school settings, and less on students in college settings. Because it is now more common than ever for students with ADHD to attend college, a wide variety of resources exist on campuses to support them. Of these resources, some of the more prominent ones include strategies for how to improve learning through more comprehensive methods of note taking and reading comprehension. However, little research exists that proves the efficacy of these strategies for this specific population. Here I show how current research on new methods for note taking and reading comprehension seems to indicate that students with ADHD can benefit from them. A key for linking this research to students with ADHD is working memory. Many recent studies in Educational Psychology show that students should take different approaches to note taking and reading comprehension based on the strength of their working memory. By investigating the specific working memory deficits of students with ADHD alongside these studies that differentiate working memory capabilities, I have identified several easily adaptable study methods that I believe will enable students with ADHD to perform to or above the academic standards set by their non-ADHD peers. I hope that this review of this literature can pave the way for future studies to prove the efficacy of the strategies I suggest.

**Drug Inhibition in HER2-Mutant Colorectal Cancer Cell Lines as a Basis for Novel Treatments**

Naveen Jain  
Mentor: Ron Bose

Understanding the molecular mechanisms of drug resistance is a prerequisite to more effective cancer treatments. Therapeutically pinpointing clinically-relevant genetic alterations represents a promising avenue for overcoming drug resistance and improving the efficacy of current treatments. Amplification of HER2, an epidermal growth factor receptor (EGFR) family receptor tyrosine kinase, has been extensively studied because of its role in key cell proliferation pathways. However, somatic mutations in HER2 are only recently being explored as clinically-relevant. Genomic analysis has identified HER2 amplification and somatic mutations in 7% of colorectal cancer patients. While HER2 amplification represents a known mechanism of resistance to cetuximab in colorectal cancer, the effects of HER2 somatic mutations in colorectal cancer are relatively unknown. Introduction of the HER2 mutations V842I, L866M, L755S, S310F, and V777L into colon epithelial cells increased cell signaling pathways and anchorage-independent cell growth, indicating that they are activating mutations. Introduction of the HER2 mutations into colorectal cancer cell lines produced resistance to the EGFR-targeted antibodies cetuximab and panitumumab. However, the HER2 mutations were potently inhibited by nanomolar doses of the second generation, irreversible tyrosine kinase inhibitors neratinib and afatinib. This indicates HER2 somatic mutations serve as a resistance mechanism to EGFR-targeted antibodies and may serve as drugable targets in colorectal cancer. HER2 gene sequencing of 48 cetuximab-resistant, quadruple WT (KRAS, NRAS, BRAF, and PIK3CA WT) colorectal cancer patient derived xenografts (PDXs) identified 4 PDXs with HER2 somatic mutations. Treatment of these PDXs with single HER2-targeted therapy (trastuzumab, neratinib, or lapatinib) delayed tumor growth, but dual HER2-targeted therapy (trastuzumab combined with neratinib or lapatinib) produced durable shrinkage of the tumors in mice. These data provide a robust preclinical rationale for clinical trials focused on HER2 somatic mutations in colorectal cancer.
UNCOVERING HIDDEN GEMS IN DICTYOSTELIUM DISCOIDEUM: THE SEARCH FOR BACTERIAL ENDOSYMBIONTS

Daniela Anabel Jimenez
Mentor: Joan Strassmann

Symbiosis plays a major role in the evolution and the creation of major life forms on earth. Bacteria acting as mutualists can affect their host by protecting them against pathogens, providing nutrients to the host or creating pathways for synthesis of different compounds. Symbiosis has already been observed between the social amoeba, Dictyostelium discoideum and the different strains in the bacterial genus Burkholderia. Some clones of D. discoideum that carry Burkholderia are known as farmers because among many traits they also carry food bacteria with them through their dispersal stage. This provides an advantage for them since they can seed their own crop in environments lacking food bacteria. These symbiotic bacteria were identified by isolating and growing the bacteria associated with the amoeba on a media plate. However, there are many symbiotic bacteria that have adapted to growing inside their host and are unable to be cultured by standard laboratory methods. In fact, recent amplification of bacterial DNA directly from non-farmer D. discoideum has shown that lab clones contain additional bacteria. This suggests that there might be other bacterial species that haven’t been detected yet.

To look into the prevalence and diversity of these unculturable endosymbionts, we are screening a wild population of D. discoideum clones using a culture-independent method, DNA sequencing. So far we have found four endosymbionts that are closely related to other species of endosymbionts in different Amoebozoa. We will use phylogenetic analysis to identify their relatedness to those other previously identified endosymbionts. Using this information we can begin to characterize the function and importance of these additional endosymbionts and how they affect the ecology and evolution of their host.

PHENOTYPE AND SYMBIOSIS IN THE SOCIAL AMOEBA DICTYOSTELIUM DISCOIDEUM

Kai Jones
Mentors: David Queller, Joan Strassmann, and Debra Brock

Symbiotic interactions between bacteria and eukaryotes can be beneficial to both parties. Some clones of the social amoeba Dictyostelium discoideum, called farmers, maintain symbiotic relationships with bacteria. Farmer clones that carry the bacteria Burkholderia xenovorans have distinct traits associated with the farming symbiosis: short migration distances, resistance to the toxicity of the host-associated bacteria, and prudent harvesting of bacteria. To begin, short migration distance inhibits farmers because they may not be able to migrate to higher resource environments. Resistance to B. xenovorans is beneficial when the host farmer is in competition with a non-farmer because this non-food bacteria, B. xenovorans, hurts non-farmers by inhibiting their growth. Also, prudent harvesting leads to farmers saving food even in low resource environments. These traits, with their advantages and disadvantages could be either bacterially conferred, or the amoebae could have evolved these traits in response to long association with the bacteria. In order to test this, we grew five non-farmers and five farmers on antibiotic plates to remove host-associated bacteria from farmer clones, essentially curing them. Then, we performed a series of assays to compare the phenotypes of cured and uncured farmer and non-farmer clones. We found that the short migration distance is a bacterially conferred trait. The resistance to B. xenovorans however, can be attributed to genetic adaption in the clones. Finally, the prudent harvesting trait seems to represent an intermediate trait with some aspects being bacterially conferred and others being associated with a genetic adaption in the clones. These data suggest that the association between host farmer and B. xenovorans is not recent since some traits are not just bacterially conferred but show genetic adaptation of the host.

CLEARING PAYMENT VECTOR MODELING

Sam Jones
Mentor: Zachary Feinstein

This project examines how different strategies of selling stocks in a financial crisis effect both the health of a financial system and the firms within that system. The systems we study are interconnected networks of firms in which each has financial liabilities to others. The value of each firm is often dependent on the payoffs they receive from their claims on other firms in the financial system. To determine the health of the system and value of each firm, we find a clearing payment vector that efficiently clears the obligations of each firm. We first consider systems in which each firm has cash, but no additional assets, and systems in which each firm has cash and a variable amount of a specific stock. We then consider systems more relevant to real-world settings in which each firm has cash and variable amounts of multiple stocks. In these systems, each firm has many possible strategies for selling stocks. Any given strategy can change the final value of the firm, which in turn affects the final value of connected firms and the overall health of the system. We analyze the different strategies and apply them to different systems to determine which are best for the health of an individual firm and which are best for the health of the system. The findings of this project can be used by individual firms as well as system regulators to determine the best strategies in a financial crisis.
THE ROLE OF Gpr126 IN MYELIN MAINTENANCE AND REGENERATION
IN THE PERIPHERAL NERVOUS SYSTEM
Jessica Joseph
Mentor: Kelly Monk

Myelin is a multilayered insulating membrane that allows rapid propagation of electrical signals and provides neurotrophic and cellular support to axons. Specialized glial cells called oligodendrocytes synthesize myelin in the central nervous system (CNS), while Schwann cells myelinate axons in the peripheral nervous system (PNS). Irregular myelin formation or myelin degeneration leads to debilitating diseases like multiple sclerosis (MS) in the CNS and Charcot-Marie-Tooth Disease in the PNS. However, the molecular mechanisms behind myelin maintenance or regeneration after injury or disease are not well understood. Adhesion G Protein-Coupled Receptors (aGPCRs) are a unique class of GPCRs, in that they have a large extracellular N-terminus containing domains that may be responsible for cell-cell or cell-matrix interactions, as well as the classic 7TM domain within the cell membrane involved in signaling. Previous studies have shown the necessity of the aGPCR Gpr126 for normal Schwann cell growth and myelin formation during both mice and zebrafish PNS development. Within Schwann cells, Gpr126 plays a vital role in PNS myelination by coupling to heterotrimeric G-proteins and directly regulating cAMP levels. A recent study from our lab has shown that during development, the N-terminus of Gpr126 plays important role in radial sorting, while the C-terminus is crucial for the later stages of myelination. Interestingly, these studies showed that the expression of Gpr126 is maintained in adult Schwann cells, suggesting there may be a function of the aGPCR in adult cells. This finding has led to our research on the role of Gpr126 in myelin maintenance and remyelination in the PNS. To do so, we utilized a Schwann cell specific tamoxifen-inducible conditional knockout (PLP-CreERT2;Gpr126fl/fl) mouse model (icKO). In this study, we show that the deletion of Gpr126 does not affect myelin maintenance, but causes severe delays in remyelination after nerve-crush injuries.

SELVES PORTRAIT: A SENIOR THESIS PORTRAYING SCHIZOPHRENIA THROUGH DANCE
Samantha Karlow
Mentor: David Marchant

Schizophrenia is a mental disorder that affects approximately 1% of the human population. This disorder is incredibly complicated, and much more research is needed for it to be fully understood. There are many diverse symptoms associated with schizophrenia, and they can be present in different forms and combinations. It is important that we work not only to understand the mechanisms underlying this disorder but also to be compassionate and understanding of the reality experienced by those who suffer from schizophrenia.

Selvès Portrait is a senior dance thesis production that attempts to portray the experience of one individual’s presentation of schizophrenia. Based on real instances of the disorder, the production allows viewers to follow a schizophrenic woman as she interacts with her disordered mind, treatment, and altered reality.

This production aims to offer audiences a more in-depth understanding of schizophrenia than could be gained from textbooks or articles. Besides learning about the facts of mental disorders, it is important that we are aware of the presence of mental illness around us and the struggle endured by countless numbers of our fellow humans. The goal of Selvès Portrait is to remind viewers of how much mental health matters. In addition, audiences will come away with a better understanding of the experiences of those people who suffer from schizophrenia.

Selvès Portrait provides an example of research into abnormal psychology through movement. Factual research became the foundation of the production, but this information was then transferred onto the bodies of seven experienced dancers. This project goes beyond written research and uses artistic interpretations to transfer knowledge from words to dance, and on to the minds of its audience members.

USING LEAF WAX BIOMARKERS TO CONSTRAIN LAND-USE CHANGES
ASSOCIATED WITH MISSISSIPPIAN SETTLEMENTS
Allison Karp
Mentor: Alex Bradley

The largest settlement of the Mississippian Native American society, Cahokia Mounds, was inhabited from approximately 800–1350 CE. To better understand the environmental context of Cahokia’s decline, we attempt to constrain widespread agriculture associated with this settlement. We examine stable carbon isotopes in leaf waxes through lake sediment cores taken from Horseshoe Lake (Madison County, IL), about a mile away from the Cahokia site. By measuring the relative 13C content of leaf waxes through the sediment core, we can detect shifts coincident with the onset and decline of agricultural land use by the Cahokian settlement. We constructed a maize contribution model using our 13C/12C values to place numerical constraints on maize contribution to the record. Our results suggest maize agriculture peaked in the area at 1037±80 CE, comprising between 4% and 53% of the terrestrial plant community. This coincides with the largest expansion of the Cahokia settlement suggesting that maize agriculture was linked to the enlargement of the settlement.
IS A PROBABILISTIC CHOICE REALLY A DELAYED CHOICE?
DISCOUNTING OF REPEATED GAMBLIES

Brian Katz
Mentor: Leonard Green

Most research on delay and probability discounting has examined choices in “one shot” scenarios. Many everyday situations, however, involve repeated choices. The current study compared the effect of repeated gambles with “one-shot” gambles on rates of discounting. One hundred participants were randomly assigned to one of 4 conditions that differed in the amount of a probabilistic hypothetical reward ($50 and $2,000) and the delay between gambles (1 week and 2 months). In each condition, participants were offered a series of choices between receiving a smaller amount for certain and playing a game for the chance to receive the larger amount. The game involved repeated gambles to win the larger amount, with a constant probability of winning on each gamble. Within conditions, the probability of winning the larger amount varied from 80% to 5%. In addition, the number of tries the participants were permitted to win the gamble varied from 1 (a one-shot) to unlimited. No overall effect of amount of the probabilistic reward on discounting rate was observed. However, the larger probabilistic amount was discounted more steeply in the “one shot” gamble condition (consistent with the reverse-amount effect obtained with probability discounting), whereas the larger probabilistic amount was discounted less steeply in the unlimited gambles condition (consistent with the amount effect obtained in delay discounting). Furthermore, rate of discounting increased as the delay between repeated gambles increased from 1 week to 2 months and as the number of tries to win the reward decreased. The current results are the first to show that the hyperboloid function accurately describes patterns of discounting under situations involving repeated gambles. Moreover, the results provide support for the hypothesis that when given multiple opportunities to win a probabilistic reward, subjective value is a function of the expected delay rather than the probability of reward.

THE SERVICE ECONOMY OF SPONSORSHIP:
EXAMINING THE LABOR OF PRODUCING THE POOR IN GUATEMALA

Daniel Kennedy
Mentor: Bret Gustafson

The child sponsorship industry generates billions of dollars every year that are spent on development initiatives throughout the world. Largely based in Europe and North America, these organizations depend on the selling of “sponsorships” a process in which a donor makes a monthly payment to become the “sponsor” of an individual child. Sponsorships are marketed and sold through the generation of individual personal narratives that appear in online catalogs. Scholarly and ethnographic work has documented sponsorship practices from the perspectives of donors and recipients, but surprisingly little work focuses on the facilitators of this process. This project tracks the work of Guatemalan employees at one such organization, Kids International, specifically examining the in-between space they occupy. Through extensive participant observation, I argue that these workers do not work in international development, but instead form part of a hierarchical service economy of sponsorship.

INFORMATION PROCESSING BIASES OF ATTENTION FOR EMOTIONAL FACES IN DEPRESSED YOUTH

Yuji Kim
Mentor: Michael Gaffrey

This research examines information processing biases of attention for emotional face stimuli in adolescents of different diagnostic groups. The work is constructed upon the premise that major depressive disorder (MDD) is characterized by biases in the processing of information from the environment, and one’s characteristic ways of attending to, interpreting, and remembering life events contribute vulnerability to the development and maintenance of depression. Since depression has been associated with an attentional bias towards negative stimuli, the main goal of this study is to explore how attentional biases can affect cognitive processing and to elucidate potential risk or protective factors for the early onset and maintenance of depression. A study conducted at Washington University School of Medicine tested attentional biases for fearful, sad, and neutral faces in two diagnostic groups of adolescents: MDD and No MDD. Participants in the MDD group were those with a history of MDD and/or current MDD at the time of assessment. Participants in the No MDD group were those without a history of or current MDD. A total of 123 participants completed the Implicit Emotion Regulation Task, an information processing paradigm that assessed attention. The task involved discriminating the orientation of two peripheral bars with task-irrelevant, centralized emotional faces. Results showed that MDD group participants were significantly faster than No MDD group participants on the task for all face types, suggesting an enhanced ability to disengage from negative information. The findings indicate a pattern of resilience or a protective factor among adolescents who have experienced previous or current depression.
COSMOLOGICAL SIGNATURES OF MASSIVE SELF-INTERACTING NEUTRINOS
Christina Kreisch
Mentor: Francesc Ferrer

Exploring potential effects of the neutrino’s mass can reveal new and exciting knowledge about the universe. In the standard cosmological model, neutrinos decoupled from the primordial plasma at $T \sim 1.5$ MeV and then began free-streaming. However, the presence of new interactions in the neutrino sector, such as those responsible for neutrino mass, can significantly delay the onset of neutrino-free streaming. These effects alter the anisotropic stress history, which is measurable with observables like the Cosmic Microwave Background (CMB) and matter clustering. For the first time, we study the cosmological physics of self-interacting neutrinos while self-consistently taking into account the neutrino mass. We present the results of numerically implementing the mass corrected collision term in the Boltzmann equation. We find the neutrino mass and self-interaction have an additive damping effect on the matter power spectrum for small scales and alter the phase and amplitude of the CMB temperature power spectrum.

“SCIENCE IS NOT MATHS”:
MANAGING UNCERTAINTY AND INFERTILITY IN INDIA’S SILICON VALLEY
Amrutha Kumaran
Mentor: Carolyn Sargent

In recent years, India’s assisted reproductive technology (ART) market has grown beyond the government’s ability to regulate it and raised new issues of ethical practice. Hyderabad has experienced a technology boom in the last decade and is now host to a burgeoning ART industry catering to elite infertile couples. The core questions motivating this ethnographic study were: How did the clinics in question originate? How do medical staff view the services they offer to clients? How do doctors negotiate uncertainty and perform ethical relationships with clients? In the summer of 2014, I spent three months observing consultations with patients, outpatient procedures, and laboratory work at three ART clinics in Hyderabad. Infertility, childlessness, and adoption are highly stigmatized in India for a variety of socioeconomic reasons, and pursuing treatment is emotionally and financially exhausting. Doctors construct their authority by citing statistical outcomes for treatments based on patients’ medical conditions. Statistics are intended to temper expectations and encourage caution, but in practice they act as evaluations of the inherent quality of patients’ bodies and present a misleading world of potential “opportunities” to desperate infertile couples. Doctors try to compensate the power imbalance in clinical interactions by emphasizing transparency and consent documentation. However, they face pressure to abandon this model of care when patients compel them to fulfill their moral obligation to give them a child by any means. Fertility clinics participate in advanced selection against female children and reiterate the Indian state’s exploitative relationship with poor and female bodies. At the same time, doctors carry the burden of healing the stigma and suffering of their patients and are powerful advocates for the infertile. This study highlights a need for more attention to the influence of Indian medical elites on the practice of biomedicine in the subcontinent.

STAKEHOLDER PERCEPTIONS OF A WEB-BASED DECISION AID TO SUPPLEMENT CANCER CLINICAL TRIAL INFORMED CONSENT
Marie D. Kuzemchak
Mentor: Mary Politi

Despite their value to the advancement of cancer treatment, the rate of participation in cancer clinical trials is very low. To support individuals’ decisions about whether to participate, interventions such as decision aids have been developed to provide knowledge about clinical trials and promote patients’ deliberation process during informed consent. However, in order for decision aids to be effectively integrated into cancer clinical trials decision making, they must be supported by those who develop, deliver, and approve trial informed consent procedures. This study assessed the attitudes of such stakeholders toward a web-based decision aid developed to supplement the cancer clinical trial informed consent process. We administered a survey with close- and open-ended questions examining feasibility, acceptability, and sustainability of implementing web-based decision aids about cancer clinical trials. Survey questions were structured based on a well-established framework of implementation research. Overall, participants across roles and disciplines felt this tool and others like it would contribute positively to patient care. However, a number of constraints on implementation were identified, in particular limited time and limited resources. Many participants felt the tool accessibley presented information about trials, allowing individuals to make decisions about participation consistent with their values and preferences. However, few indicated regularly referring patients to decision support interventions. Many participants also spoke of real or perceived pressure on patients to decide about participation in one visit. These results reveal a continued gap between stakeholders’ perceptions of the positive contribution decision aids could make to patient care and their implementation into routine clinical practice. Disseminating decision aids about cancer clinical trials through resources currently recommended or used by practitioners could improve their implementation. Permitting patients the time to fully deliberate their decision, perhaps with decision aids available outside of the clinical encounter, could improve cancer clinical trials decisions.
The Advances of Science, the Constancy of Suffering: A Cross-Disciplinary Study of the Patient Experience as It Is Represented in Montaigne’s Essais

Marie D. Kuzemchak  
Mentor: Colette Winn

In 1578, French philosopher Michel de Montaigne was diagnosed, at the age of forty-five, with kidney stones, a condition at the time incurable that promised the patient a painful life and a premature death. An attempt to make sense of his illness, his Essais, first published in 1580, provide a valuable firsthand account of the patient experience in sixteenth-century France. This cross-disciplinary study examines the reflections on suffering that dominate the text of the Essais in two parts. In the first part, I situate the representation of the illness experience in its historical context by comparing the references Montaigne makes to medicine and to physicians to the state of medicine described in texts of and on the era. In the second part, I analyze the progression of Montaigne’s mental state over the course of the text, applying to his account modern models developed by anthropologist Arthur Kleinman and psychiatrist Elisabeth Kübler-Ross to explain the patient experience. The portrayal of the practice of medicine in Montaigne’s text as an uncertain but evolving exercise aligns with the sources I reviewed. Analysis of the portrayal of the patient experience reveals the same attempt to make sense of illness by assigning meaning to signs and symptoms that Kleinman’s framework of explanatory models outlines. Likewise, the evolution of structure and content over the course of the text evidences Montaigne’s progression through the five stages of grief proposed by Kübler-Ross. By reminding us of the human experience of medicine that remains constant despite scientific progress, Montaigne’s Essais rest as pertinent, as accessible today as at the time of their composition.

Isolation and Characterization of the Novel Mycobacteriophage Clarice

Tiffany La, Rachel Mickelson, Darby Turner, and Andrew Wellen  
Mentor: Sarah Elgin

Bacteriophage represent an incredibly diverse group of viruses. Many mycobacteriophage remain undiscovered. In our research we isolated the novel bacteriophage Clarice. Clarice was found in a soil sample from O’Fallon, IL, an area from where relatively few samples have been collected. Following direct plating, it was established that Clarice was lytic, forming small, clear plaques when grown on the host bacterium, Mycobacterium smegmatis. Electron microscopy of phage Clarice revealed a distinctive head and tail morphology, with the head being approximately isometric and the tail very short. Through sequencing, Clarice’s genome was found to be 154,450 base pairs in length and highly similar to many cluster C phages. The conclusion that Clarice lies in cluster C is supported by the short, thick tail structure, which is characteristic of this group. Using the programs Glimmer and GeneMark, phage Clarice is estimated to have 222 genes. BLAST, HHPred, and Phamator were used to assign gene function. Even so many genes cannot be functionally annotated. As a cluster with an average genome length of over 150 kb, many parts of the cluster C phage genomes remain unexplored. The isolation, sequencing, and genomic annotation of Clarice will contribute to a more complete understanding of this cluster, as well as mycobacteriophage on the whole.

Brandon Lau  
See Denton Hui

Novel Nuclear Proteins in Tetrahymena thermophila

Tobie Lee, Hannah Lo, and Euna Park  
Mentor: Douglas Chalker

Tetrahymena thermophila is a ciliated protozoan consisting of two nuclei, a somatic macronucleus and a germline micronucleus. During the growth phase of Tetrahymena, the macronucleus controls gene expression and while the micronucleus remains transcriptionally silent, it becomes active during conjugation. We have identified three nuclear proteins. Ttherm_00357110, Ttherm_00678190, and Ttherm_00372470 in Tetrahymena thermophila. We believe these proteins play an important role in gene expression and replication.

To determine this, we examined gene expression levels and protein YFP localization during various phases of the Tetrahymena cell cycle. Ttherm_00357110 and Ttherm_00678190 were shown to be localized in the macronucleus during growth and conjugation, but most highly expressed during mid-conjugation. They appear to be involved in gene expression through DNA repression and activation respectively though histone modifications. Ttherm_00372470 localized in the micronucleus and has a very narrow window of expression during the early conjugation stage. As a result, we suggest it plays a role in spindle assembly. To understand these proteins more, we plan to conduct a series of co-localizations with various nuclear proteins involved in gene expression and cellular replication.
Finding an Alternative Functional Metagenomics System to Discover Novel Vancomycin Resistance Genes

Yang Lee
Mentor: Gautam Dantas

Infections and deaths from antibiotic resistant bacteria have increased drastically over the last few decades with major societal and healthcare costs. Functional metagenomics screening is a culture-independent technique used to find new antibiotic resistance genes. This tool has been only confined to Gram-negative antibiotics resistance genes because the customary host, E. coli, is Gram-negative, impeding the discovery of novel Gram-positive resistance genes.

The goal of our project is to develop a pseudo-Gram-positive host for use in functional metagenomics, thereby allowing de novo discovery of Gram-positive antibiotic resistance genes. Preliminary evidence showed that E. coli was susceptible to Gram-positive antibiotics at low temperatures, and the minimum inhibition concentration (MIC) to vancomycin, a Gram-positive antibiotic, of E. coli at 15°C on LB (Lysogeny Broth) agar was found. However, the MIC could not be replicated on MH (Mueller Hinton) Agar, the customary medium used for MIC testing, due to high divalent salt contents of MH Agar. A separate experiment confirmed that the higher salt concentration was the culprit for vancomycin resistance of E. coli at 15°C as E. coli on LB Agar with Mg²⁺ and Ca²⁺ added was resistant. It was found that transforming DH10B E. coli with empty pZE21 plasmid carrying a known kanamycin-resistant gene led to unexpected vancomycin resistance, demonstrating the presence of a vancomycin resistance gene in pZE21 plasmid. We solved this by switching the host to the engineered genetically competent cell E. coli, which did not exhibit vancomycin resistance at 15°C when transformed with an empty pZE21 plasmid. We are currently exposing E. coli with a pZE21 plasmid containing a known vancomycin resistant cassette to determine if the temperature-susceptible functional metagenomics system is suitable to find Gram-positive resistance genes. Once this system is working, we will use it to identify novel resistance genes in the clinic and the environment.

Pharmacology of Organic Cation Transporters (OCTs): Focus on Structure-Function Relationships in OCT3 (SLC22A3)

Dan Li
Mentor: Colin Nichols

Organic Cation Transporters (OCTs; SLC22A1-3) are polyspecific, facilitative transporters that play major roles in metabolite and drug clearance. OCT1 and OCT2 are expressed in hepatocytes and proximal tubule cells, whereas OCT3 is expressed in astrocytes. OCTs are promising drug targets, and thus elucidating the molecular mechanisms of substrate recognition in OCTs is crucial for rational drug design. While small, monovalent OCT substrates have been well-characterized, the ability of OCTs to transport larger, multiply charged cations remains largely unexplored. Xenopus laevis oocytes expressing mammalian OCTs were used to assess transport of polyamines, ubiquitous polycationic cations of broad physiological and pharmacological importance, but for which transport mechanisms in eukaryotic cells are unknown. Comparative dose-response analysis showed that trivalent spermine is transported with lower affinity, but at similarly high turnover, than model substrate methyl-4-phenylpyridinium (MPP⁺). To further investigate substrate specificity in OCTs, polyamine analogs of varying charge and hydrophobic character were screened for competition against MPP⁺: hydrophobicity was a principal requirement for polycationic substrate recognition, and OCT3 exhibited significantly higher hydrophobicity requirements than the other two isoforms. A hydrophobic cleft potentially capable of accommodating a variety of structures has been identified in OCTs by homology modelling. In OCT3, replacement of an absolutely conserved residue within this pocket, D475 (TM11), abolished MPP⁺ uptake, suggesting it is obligatory for OCT3-mediated transport, potentially by stabilizing positive charges within the substrate. Mutations at putative binding pocket residues that are not conserved in OCT3 to the corresponding residue in OCT1 – L160F (TM2), F222Y (TM4), F447L (TM10), and E448Q (TM10) – decreased MPP⁺ uptake, but partially recapitulated the pharmacological profile of OCT1; thus, interactions of putrescine, spermidine, spermine, and potent OCT1 blocker 1,10-diaminodecane (DA10) with wild-type OCT3 were weak, but were significantly potentiated in mutant transporters. These results suggest that substrate specificity in OCTs is determined at the hydrophobic cleft.

Racial and Economic Diversity Interactions at Elite, American Universities

Landon Lichtenstein
Mentor: Gregory Ott

Elite, American universities strive to achieve diversity within their student body. This work explores many factors surrounding this goal from the perspective of future and current university students, university administrations, and society as a whole. Specifically, I analyze why and how universities interact with and achieve both racial and economic diversity within their student body, why both these factors are significant, and how students are influenced by university diversity actions, such as viewbooks and on-campus posters. Motivated by how my current university interacts with diversity, I take a closer look at Washington University’s relations with economic and racial
diversity. I conclude that elite, American universities should focus on achieving both an economically and racially diverse student body with a welcoming campus climate to guarantee its students the most beneficial college experience.

A NOVEL METHOD FOR THE DYNAMIC MECHANICAL CHARACTERIZATION OF INTACT MURINE INTERVERTEBRAL DISCS

Jennifer W. Liu
Mentors: Simon Tang

Intervertebral disc degeneration (IVD) is highly correlated with lower back pain, and thus understanding the mechanisms of IVD degeneration is critical for the treatment of this disease. Utilizing mouse models to probe the mechanisms of degeneration is especially attractive due to the ease of manipulating mouse models and the availability of transgenics. Yet characterizing the mechanical behavior of mice IVDs remain challenging due to their minute size (approximately 310 μm in height and 1810 μm² in cross sectional area). We have thus developed a simple method to dynamically characterize the mechanical properties of intact mouse IVDs. The IVDs were dissected with the endplates intact and dynamically compressed in the axial direction at 1% and 5% peak strains at 1 Hz using a micro indentation system. Utilizing this novel approach, we examined the effects of in vitro ribosylation and trypsin digestion for 24 or 72 hours on the viscoelastic behavior of the whole murine IVD. Trypsin treatment resulted in a decrease of proteoglycans and loss of disc height, while ribosylation had no effect on structure or proteoglycan composition. The 72-hour ribosylation group exhibited a stiffening of the disc, and both treatments significantly reduced viscous behavior of the IVDs, with the effects being more pronounced at 5% strain. Here we demonstrate a novel method to mechanically characterize murine IVDs and detect strain-dependent differences in the elastic and the viscous behavior of the treated IVDs due to ribose and trypsin treatments.

ALTERED TRABECULAR BONE IN AN ANIMAL MODEL OF POST-TRAUMATIC ELBOW STIFFNESS

Margaret Liu
Mentor: Spencer Lake

Joint stiffness and contracture commonly occur following traumatic injury to the elbow, and lead to pain, functional impairment and loss of motion. Recently, we developed an animal model of post-traumatic elbow stiffness to elucidate the development and progression of this debilitating condition. The purpose of this study was to evaluate whether changes to bony architecture correlate with the development of elbow stiffness.

Long-Evans rats were used in this study and split into four groups: Control, Sham (joint exposed, followed by skin closure with no induced injury), Injury I (surgically created anterior capsulotomy), and Injury II (anterior capsulotomy and lateral collateral ligament transection). All contralateral elbows were uninjured. Post-surgery, operated limbs were immobilized for six weeks. Following immobilization, rats were sacrificed and bilateral elbows were dissected. Micro-CT analysis then assessed bone volume/total volume, trabecular number, trabecular thickness, trabecular spacing, and bone mineral density. The lateral half of the distal humerus and the anterior half of the trochlear notch were selected for analysis, based on likelihood of osseous changes in these locations post injury and immobilization.

Rats that underwent any surgical procedure showed changes to the trabeculae in the humerus and ulna, in both elbows. In the humerus, BV/TV, trabecular number, trabecular thickness, and bone mineral density decreased when compared to controls. In the ulna, BV/TV, trabecular number, and bone mineral density all significantly decrease, while trabecular thickness moderately decreased in all samples compared to controls. Trabecular spacing increased in both the humerus and the ulna. These results suggest that bone changes were due primarily to immobilization and not to specific soft tissue injuries. Thus, it is likely that other factors contribute much more to the development of joint stiffness and contracture than altered trabecular bone, which does not correlate with injury severity or degree of reduced joint mechanics.

Hannah Lo
See Tobie Lee

SCHATTEN-CLASS TRUNCATED TOEPLITZ OPERATORS

Patrick Lopatto
Mentor: Richard Rochberg

Truncated Toeplitz operators are a generalization of the classical Toeplitz operators introduced by Sarason in 2007. Our research looked at the problem of determining when these operators lie in a given Schatten ideal. We completely characterize such operators when they have an analytic symbol or belong to the ideal of Hilbert-Schmidt operators. We also study model spaces generated by Blaschke
products associated with thin sequences, model spaces generated by certain types of singular inner functions, and operators associated with a class of very smooth symbols.

Michael Lory
See Matthew Ayanian

IDENTIFICATION OF RARE VARIANTS IN ALZHEIMER’S DISEASE
Alexander J. Lu
Mentor: Carlos Cruchaga

Much progress has been made in recent years in identifying genes involved in the risk of developing Alzheimer’s disease (AD), the most common form of dementia. Yet despite the identification of over 20 disease-associated loci, mainly through genome wide association studies, a large proportion of the genetic component of the disorder remains unexplained. Recent evidence from the AD field, as with other complex diseases, suggests a large proportion of this “missing heritability” may be due to rare variants of moderate to large effect size, but the methodologies to detect such variants are still in their infancy. The latest studies in the field have been focused on the identification of coding variation associated with AD risk, through whole-exome or whole-genome sequencing. Such variants are expected to have larger effect sizes than GWAS loci, and are easier to functionally characterize, and develop cellular and animal models. This work explores the issues involved in detecting rare variant associations in the context of AD, highlighting some successful approaches utilized to date.

ROBOTIC BIN PICKING USING 2 KINECT CAMERAS SIMULTANEOUSLY
Wei Luo
Mentor: Ed Richer

Adding a 3-D camera to a robotics system can improve throughput by computing the coordinates of the next object while the robot is busy with another task. In this case, we are using the Kinect Camera for our 3-D camera. However, due to the limited resolution of Kinect Camera and the fixed position of the camera, we cannot always identify the exactly precise area where the target is. For example, a picture taken from front viewing angle is totally different from top viewing angle, which sometimes results in failed recognition. Because targets are of different poses, some of which may lie down or stand up, a single camera cannot effectively recognize targets. Since targets in a picture taken from different angles have different poses, setting a second Kinect Camera at a different position can help change poses of targets in the second picture, which means robotics can get more information of targets. By implementing cross-correlation of the template and targets, we can find the location with high probability. Choosing the area with highest probability from both pictures taken by first camera and second camera undoubtedly enhances the accuracy of target recognition. After identifying shapes and locations of targets, we obtain the coordinate information in the pictures and transform them to the robotic coordinates. Once the robot has the coordinates, it can move to that location and pick up the object.

William Lyons
See Katherine Alexander

Hunter Malasky
See Steven Grigsby

PREDICTORS OF DIFFERENT TYPES OF HAPPINESS ACROSS THE STATE-TRAIT CONTINUUM
Seth Margolis
Mentor: Randy Larsen

With the emergence of positive psychology, happiness has received increasing attention from psychologists. But it is the trait of happiness which has received the vast majority of attention. I argue that states of happiness are more relevant when making decisions about what one should do. This study seeks to determine the extent to which happiness findings extend to more state-like measures of happiness. Predictors of trait happiness, daily mood, and aggregate affect valence are examined. The latter two were examined with a new activity log methodology. Results showed that positive and negative affect (as measured by the PANAS-X) correlated better with more trait-like
measures of happiness than state-like measures of happiness. The PANAS-X was alarmingly poor at predicting aggregate affect valence. Personality was a stronger predictor than activity selection of any type of hedonic happiness across the state-trait continuum. Interestingly, conscientiousness was a strong predictor, particular for aggregate affect valence. The same was true for food healthiness. Personality didn’t seem to affect activity selection but there were significant interaction effects between personality and activity in predicting affect valence. Implications of these findings are discussed, focusing particularly on current findings and future avenues of research on aggregate affect valence.

**NON-INVASIVE HOLTER MONITOR SUIT FOR ECG RECORDING IN CONSCIOUS, UNANAESTHETIZED MICE**

Joseph Marmerstein  
Mentor: Igor R. Efimov

Cardiovascular disease is the number one cause of death in the United States. In many cardiac disorders, normal electrical activation of the heart is impaired, which can be measured using body surface electrocardiograms (ECGs) in patients. Likewise, for mouse models of cardiac rhythm disorders, characterization of in vivo cardiac electrophysiology through body surface potentials is an important, albeit challenging, task. Currently, several in vivo techniques are employed to record mouse ECGs. These methods, however, suffer from important drawbacks: anesthesia impacts heart rhythm, and implantable devices require surgery. Only surface paw ECGs allow for non-invasive recording in unanaesthetized animals, but these recordings are often deteriorated by noise (including motion and breathing artifacts) and sympathetic effects on heart rate. Thus, we aimed to develop a novel device for recording non-invasive ECGs in unrestrained mice.

The performance of the suit was tested relative to a surface paw recording device, the ecgTUNNEL (emka Technologies). Relative to the ecgTUNNEL, we found that the mECGs displayed significantly increased SNR for the QRS complex (average SNR for the suit was 1.5-fold greater, p = 0.0344), significantly less baseline drift, and fewer motion artifacts. There was no significant difference in SNR for the P-wave between the two methods, because of the small P-wave amplitude in mice, but our preliminary data suggest the mECGs can more reliably measure P-waves.

Based on our analysis, the mECGs outperforms the ecgTUNNEL in terms of QRS signal-to-noise ratio. In addition, the mouse suit has the potential to collect ECGs without interrupting the behavior or sympathetic tone of the mouse, similar to a Holter monitor in humans. Thus, the mECGs should both expand researchers’ ability to obtain ECG data from mice studies of in vivo cardiac electrophysiology, and improve the quality of ECG data obtained from these mice.

Alejandro Martinez  
*See Ji Hyun Ahn*

**BARRIERS TO ACCESS:**  
**AN ANALYSIS OF OBSTACLES TO OBTAINING SERVICES FOR BOSNIAN IMMIGRANT SURVIVORS OF INTIMATE PARTNER VIOLENCE IN ST. LOUIS**

Christy Marx  
Mentor: Jami Ake

Research shows that immigrants and refugees experience intimate partner violence in different ways and at higher rates than those from other populations. These victims also face many barriers to accessing support services that are in place for survivors of intimate partner violence, such as language barriers, lack of knowledge of the United States legal system, and distrust of police. In St. Louis, Bosnians currently make up approximately five percent of the city’s population, yet they represent an even smaller percentage of people attempting to utilize services available to assist survivors of intimate partner violence, such as transitional housing, orders of protection, and domestic violence shelters. Studies have shown that intimate partner violence is present at higher rates in immigrant and refugee communities, meaning that this discrepancy is likely the result of barriers that are keeping Bosnian survivors from accessing the services they need to achieve safety. Through in depth interviews with service providers, I have gained insight into aspects of the current service system that may be excluding Bosnian immigrant survivors, and I have also developed ideas on how these services could better provide for Bosnian survivors of intimate partner violence.

Alexander Mason  
*See Ji Hyun Ahn*
Rachel Mickelson
See Tiffany La

Phoebe Moh
See Gabrielle Bleich

Understanding Symbiotic Relationships Through
Dictyostelium discoideum and Burkholderia
Stephanie Montenegro
Mentors: David Queller and Joan Strassmann

Symbiosis is the close physical association of two organisms. Death of a host is often the outcome of a relationship with pathogenic bacterium, explaining the emphasis placed on studying pathogenic symbioses. However, mutualistic symbiotic relationships also exist in which both organisms benefit, such as the relationship between the Nile crocodile and the Egyptian plover or humans housing bacteria in the intestine to aid digestion. Despite the importance of symbiotic relationships, the molecular mechanisms underlying pathogenic and mutualistic interactions are often unknown. Dictyostelium discoideum is a soil amoeba and a model organism that we will use to investigate whether a mutualistic relationship differs from pathogenesis mechanistically. Farming is a trait known to be induced in D. discoideum by exposure to the bacteria Burkholderia. When D. discoideum carries bacteria from the surrounding environment through its dispersal stage, it is considered farming and leads to the advantage of having a food source readily available at the next habitat. So far, only these in-edible, symbiotic Burkholderia isolated from farmer D. discoideum clones have been shown to induce farming in non-farmers. The genus Burkholderia, however, contains many distinct species with diverse lifestyles, including human pathogens and nitrogen-fixing plant symbionts. To determine whether other Burkholderia strains induce farming, we will grow non-farmer clones on several different Burkholderia species and concentrations. We will also examine whether these Burkholderia strains can be used as a food source for D. discoideum or are toxic. Ultimately, we will place these distinct Burkholderia isolates into a phylogeny to examine patterns between Burkholderia relatedness and farming induction ability. We will use the results of this experiment to further the study of molecular mechanisms of symbiotic relationships.

Isolation and Genomic Analysis of Type O Mycobacteriophage Vorrrps
Madeleine Mullon, Rahul Ramaswamy, Peeti Sithiyopasakul, and Leslie Sterling
Mentors: Sarah Elgin and Kathleen Hafer

In fall of 2014, mycobacteriophage Vorrrps was isolated from soil near the underpass at Washington University. The phage was isolated and purified by repeatedly infecting host Mycobacterium smegmatis. Vorrrps produces small, circular, clear plaques approximately 1 mm in diameter, indicating that it is a lytic phage. Electron microscopy reveals that Vorrrps has an unusual prolate head and a long tail characteristic of cluster O mycobacteriophage. Vorrrps is very similar to the five analyzed O cluster phages Corndog, Catdawg, Yunglamal, Firecracker and Dylan, as well as cluster O phage Mori, another phage isolated and analyzed this year. Vorrrps and Mori are the first cluster O phages to be isolated at Washington University. Vorrrps has a genome of 71,721 base pairs. One-hundred-twenty-five genes have been annotated, 68 of which run in the negative direction, the remaining 58 running in the positive direction. A majority of the suggested genes have no known function, much like other O cluster phages. Examples of interesting genes which we were able to annotate include DNA methylases, transferases, hydrophobic neighboring homology (HNH) endonuclease DNA binding protein, ATPase Associated with diverse cellular Activities (AAA ATPase), Ku, and beta clamp subunit, some of which are common across phage genomes and others which are not commonly found in mycobacteriophages of other clusters. Currently under investigation are gene overlaps, the tape measure gene chaperone frameshift, O phage common repeat sequences, and the source of the prolate head.

Development of Molecular Markers for Non-invasive Detection of Lung Inflammation
Neveda Murugesan
Mentor: Steven L. Brody

Advances in the management of acute lung injury and the related adult respiratory syndrome (ARDS) have improved mortality and morbidity rates. However, there remains a need for improved non-invasive modes of diagnosis and treatment. Currently, there is no accurate method to image and monitor lung inflammation in these patients. The goal of this study was to evaluate the performance of the virus-derived peptide vMIP-II as a tool to detect lung inflammation using positron emission tomography (PET) lung scanning. The virus-derived peptide vMIP-II binds to a known set of chemokine receptors, molecules that orchestrate inflammatory responses by
directing specific cell migration to sites of inflammation. We hypothesized that tracking chemokine receptor activity using the vMIP-II probe would enable us to visualize and monitor lung inflammation. In a mouse model of acute lung injury induced by intratracheal lipopolysaccharide (LPS), intravenously administered radionuclide-labeled probe, “Cu-DOTA-vMIP-II, resulted in a robust and specific PET signal in the lung at 4 hours and 24 hours post injury, but not at 48 hours and later. Analysis of single cell preparations of lungs from LPS-treated mice injected with fluorescently labeled vMIP-II showed a similar high 24-hour and diminished 48-hour pattern of cell binding by flow cytometry. Analysis of immune cell populations using identified specific cell populations that bound the vMIP-II probe only in the acute phase of lung injury. We propose that vMIP-II functions as a sensitive reporter of acute lung injury that can be detected using non-invasive imaging to diagnose and monitor lung injury so that therapies can be rationally administrated.

**Wolfram Protein and G-Protein Interactions**

**Hansika Narayanan**

Mentor: Thomas J. Baranski

Wolfram Syndrome is a genetic disorder that is characterized by diabetes mellitus, optic atrophy, and deafness. Wolfram Syndrome is thought to be caused by mutations in either Wolfram Protein 1 (WFS1) or Wolfram Protein 2 (WFS2), both of which cause a loss of β-cells in the pancreas, which is believed to be caused by endoplasmic reticulum (ER) stress. Research has shown that WFS1 has been linked to the negative regulation of this ER stress, thus inhibiting problems of β-cell death. WFS2, also known as CISD2, is characterized by its iron-sulfur domain.

Studies have also shown that WFS1 deficiency causes changes in G protein-coupled signaling. It is our hypothesis that WFS1 and WFS2 work in a complex to enhance signaling of G-proteins. We will test this by looking at two G-protein coupled receptors, C5a Receptor and A2B Adenosine Receptor. C5a receptor is a chemotactrant receptor that inhibits adenylyl cyclase. A2B receptor stimulates adenylyl cyclase activity in the presence of adenosine.

We used a yeast model to test the effects of WFS1 and WFS2 on G-protein signaling. Plasmids containing the gene of interest were transformed into engineered *Saccharomyces cerevisae* strains, containing different G-protein subunits: G\(_{\alpha\text{S}}\), G\(_{\alpha\text{Q}}\), and G\(_{\alpha\text{I}}\). The relative interactions of WFS1 and WFS2 protein with G-proteins A2B receptor and C5a receptor were then measured through a beta-galactosidase assay. WFS1 and WFS2 were not found to increase the signaling of C5a receptor from its baseline activity. WFS1 increased the signaling of the A2B receptor in the presence of G\(_{\alpha\text{Q}}\) and G\(_{\alpha\text{I}}\), while WFS2 did not. This suggests that there is some interaction between the adenosine A2B receptor and WFS1 protein.

**Resolution of Telomere Fragility in Mammalian Cells**

**Mai Nguyen**

Mentor: Sheila Stewart

Genomic stability is vital for the survival of cells and organisms. Telomeres, the nucleoprotein complexes capping the ends of linear chromosomes, prevent loss of genetic information and play an important role in the regulation of cell division. Due to their repetitive sequence and ability to form secondary structures, telomeres are especially sensitive to mutations or deletions of DNA replication and repair proteins. Telomere fragility, a phenotype in which multiple telomere signals or aberrant signals are observed on metaphase chromosomes stained by fluorescent *in situ* hybridization, is induced when cells experience replication stress. Although telomere fragility has been observed in many different cell types, the phenotype remains poorly understood. It is unknown what the long-term consequences of fragile telomere expression are for a cell, as telomere fragility has not been monitored over an extended period following induction. In this work, we demonstrate that telomere fragility induced by aphidicolin treatment returns to control levels after two days and remains at this baseline for at least one week. Moreover, we find that the rate of cell death remains low (<0.2%) from induction through five days following aphidicolin treatment, demonstrating that it is unlikely that the decrease in telomere fragility is due to the elimination of cells with fragile telomeres. This result, along with our observation that telomere fragility induced upon aphidicolin treatment occurs in a majority of the cells in a population, allows us to conclude that cells have a mechanism to resolve telomere fragility. Since telomere fragility can be resolved within two cell cycles, additional factors, such as prolonged replication stress or greater damage, would likely be needed to create genomic instability and initiate tumorigenesis from breakage at fragile sites. Our findings contribute to a better understanding of telomere maintenance and repair that may play a prominent role in future work on telomere and cancer biology.
**NOVEL HDAC INHIBITORS DISRUPT HIV-1 LATENCY**

**Austin Niu**  
Mentor: Lee Ratner

The ability of HIV-1 to maintain a latent reservoir that is resistant to eradication by traditional antiretroviral therapy (ART) has been a significant obstacle to achieving a cure. This latent reservoir is established early in infection in long-lived resting CD4+ T cells. The goal of the development of latency-reversing agents (LRAs) is to reactivate the provirus, thereby making the cells vulnerable to viral cytopathic effects and immune clearance, without globally activating the cell. Previous studies showed that one type of LRA, histone deacetylase (HDAC) inhibitors, is capable of inducing activation of the provirus in various models. In this study, we attempted to refine this approach through development, synthesis, and examination of novel HDAC inhibitors that have a greater potency and specificity than compounds previously characterized. In the J-Lat 10.6 model of latency, we showed that nine compounds tested were potent inducers of HIV-1 provirus activation. These results were replicated in an *ex vivo* model of latency using resting CD4+ T cells isolated from seronegative patients. Three of these candidates are largazole and its derivatives, and they were shown to be potent and specific HDAC inhibitors capable of strongly activating latent HIV-1 provirus.

*Caroline Nore*  
See Denton Hui

**SHE DON’T EVEN KNOW IT: EXPRESSIONS OF MISOGYNY, HYPER-VIOLENCE, AND SEXUALLY AGGRESSIVE THEMES IN RAP LYRICS AND HIP-HOP CULTURE**

**Courtney Oben**  
Mentor: Douglas Flowe

“Put Molly all in her champagne, she ain’t even know it  
I took her home and I enjoyed that, she ain’t even know it”  
-Rick Ross, “U.O.E.N.O” -2013

This study explores the common practice of subordinating women through rap music, focusing primarily on the shift in topics discussed in rap music before the early 1990s -from political, economic, and social activism to rampant expression of misogyny and heightened sexual violence against women of color. With the surge in rap music glorifying gang violence and celebrating the exploitation of women of color, perceptions of the black community, and specifically black-American women, have shifted to align with the hyper-violent and hypersexual representations of black men in hip-hop culture. I assert that it is arguably necessary to align with misogynistic themes for a rap artist to maintain success and relevancy in the hip-hop community. To determine the extent to which misogynistic and hyper-aggressive themes in rap music inform the public perception of the black-American male, I use select productions from DMX and 50 Cent as lenses through which to analyze the relationship between rap subject matter and financial/commercial success. To gauge the black-American woman’s response to the rap lyrics and rap music video themes, I consider reactions to hip-hop from black-Feminists to assess how much – if at all – female consumers of the genre must subconsciously disassociate themselves from the types of women discussed in rap lyrics in order to fully enjoy the music.

*Marcy Season*  
Áine O’Connor  
Mentor: Sunita Parikh

Community conflict over the parades of Northern Ireland’s ‘marching season’ has resulted in riots, protests, and individual violence for centuries, escalating during the Troubles that lasted from the late 1960s to 1998. In ‘post-conflict’ Northern Ireland, however, what explains the violence that continues to surround these parades? In an interdisciplinary argument incorporating historical case studies, memory studies, the psychology of individual bias, and evolutionary and political theories of ritual practice, I argue that the parades of the marching season offer individuals with strongly-held ethno-religious identities a place for political expression which is absent from Northern Ireland’s implicitly moderate power-sharing government. An interdisciplinary approach to these ‘intractable’ sectarian divisions corrects the tendencies of single disciplines to underestimate the disruptive impact of the country’s occasional violence, and overestimate its unmanageability.
**There’s No Accounting for Space:**
**The Effect of Territorial Concessions on Post-Civil War Peace**
Áine O’Connor  
Mentor: Sunita Parikh

Resurgent violence following civil war settlement is a problem in international relations and foreign policy that has yet to be solved. Why do negotiated peace settlements fail? What makes them succeed? This study examines 162 separate peace agreements from 47 civil conflicts. We argue that settlements providing combatant groups with direct, local control of territory reduce the likelihood of conflict recurrence. Control over land offers ex-combatants significant benefits in security and the possibility of losing those benefits is a risk that decreases the motivation to rearm. Arrangements for ex-combatants to assume power within a central government should be less successful at reducing conflict recurrence. We further propose that third-party military presence increases the risk of conflict recurrence by reducing combatants’ territorial control. We find that direct territorial provisions reduce the likelihood of conflict recurrence, and the effect of indirect control and third-party military involvement is unclear.

Batu Otkeren  
See Jonathan Finch

**An American in Europe: Orson Welles and British Commercial Broadcasting**
Trace Richard Palmer  
Mentor: Philip Sewell

Orson Welles is widely regarded as one of the most influential media personalities of the twentieth century, be it for the cultural impact of his infamous “War of the Worlds” radio broadcast, the outstanding quality of his films, or his eccentric auteur personality. However, the fact that studies of the director’s oeuvre routinely exclude his forays into television demonstrates the need for further investigation in order to provide a more complete idea of the director’s creative process. Likewise, studies of ITV, Britain’s first commercial broadcasting network, often characterize the network in opposition to the ‘cultured’ programming of the BBC while ignoring ITV’s early attempts to brand itself as culturally important. The present investigation examines the conditions surrounding the production of *Around the World with Orson Welles* (1955) for ITV’s launch to refine the understanding of both the ways in which Orson Welles leveraged his image as a serious artist to secure financing and creative control and how, from the beginning, ITV sought to compete directly with the BBC by employing show-makers with cultural clout. Finally, this study reveals how the two sought mutually beneficial collaboration and attempts to explain why this collaboration failed.

Euna Park  
See Tobie Lee

**The Role of MicroRNA-99a in Dendritic Cell Function in a Mouse Model of Multiple Sclerosis**
Cassie Parks  
Mentor: Gregory Wu

Multiple sclerosis (MS) is a demyelinating disease of the central nervous system (CNS), which is thought to be caused by an autoimmune response targeting myelin. Experimental autoimmune encephalomyelitis (EAE) is a commonly used animal model of MS that has afforded insight into the immunopathogenesis of MS. In both diseases, dendritic cells (DCs) are known to be key mediators of the immune response. In many cells, post-transcriptional regulation occurs through the expression of microRNAs, short nucleotide sequences that target complementary mRNA for degradation. Preliminary high-throughput experiments using microarrays indicated that microRNA-99a (miR-99a) may influence dendritic cell activity in EAE, though it has not previously been implicated. We hypothesized that the upregulation of miR-99a during disease leads to increased migration of DCs to the CNS, allowing for the heightened autoimmune response that is characteristic of EAE and MS. Using RT-qPCR, we identified U6 as an appropriate endogenous control to quantify microRNAs, and found miR-99a expression to be upregulated approximately 10 fold in the spinal cord vs. the spleen in both naïve and EAE mice. To investigate whether miR-99a plays a part in DC activation, its expression was compared in activated and naïve DCs in vitro; it was found to be similar in both groups. Overall, our findings confirm the presence of miR-99a in the CNS, and show that it is upregulated in the CNS to the same extent in both healthy and EAE mice. The next step, which is currently being undertaken,
includes using additional high-throughput assays to identify other potential microRNA targets that may play a role in DC activation during EAE.

**RIM Incorporation in Active Zones in C. elegans**
Ruchik Patel
Mentor: Michael Nonet

RIM, a key protein that localizes in the presynaptic terminus and works on the priming step of vesicle exocytosis, was quantified in *C. elegans*. The active zone is a part of the presynaptic membrane made up of many components that initiate synaptic vesicle docking and neurotransmitter release. Our goal is to better understand the organization of this structure. The interdependency of the relationships between active zone proteins can be understood through their effects on RIM incorporation into the active zone complex. To visualize the incorporation of the protein in active zones, the molecule was GFP tagged in *C. elegans* strains and the SAB neurons were imaged. A method of fluorescence quantification was developed and images were analyzed to assess the amount of RIM-GFP localized at synapses. Mutant active zone strains were subsequently analyzed. In *elks-1* and *elks-1 unc-13* mutants the expression levels were found to be quantifiably lower than control worms, while in *tag-168 elks-1 rip-1* mutants the expression levels were found to be higher. This may suggest similar binding domains between an active zone protein and RIM, such that when an interacting protein is knocked out, RIM is given an additional incorporation opportunity. With further analysis of various mutant strains, the absolute number and type of proteins necessary for RIM to localize to active zones under endogenous expression conditions can be determined, elucidating the complex stoichiometric protein ratios in the active zone.

**Phylogenetically Novel Species Are More Successful Due to High Competitive Ability at Local and Regional Spatial Scales**
Amy Patterson
Mentor: Tiffany Knight

While few introduced exotic species become invasive, the small number that do pose a serious threat to biodiversity, ecosystem function, and recreation, leading ecologists to study why certain species become invasive and why certain communities are prone to invasion. Several leading hypotheses seek to explain invasiveness, including the Enemy Release Hypothesis, the trait-superiority hypothesis, and the Biotic Resistance Hypothesis, but none are consistently supported in the literature. We suggest that the lack of uniting hypothesis is a result of the inability to put multiple proposed mechanisms in the same framework. We further suggest Darwin’s Naturalization Hypothesis for a unifying framework along with a mechanistic approach and a view of multiple spatial scales. We address this by conducting a study seeking the response of the effect of a competitor-reduction treatment to phylogenetic novelty for native and invasive species over local and regional scales. We address (1) whether phylogenetic novelty correlates with high competitive ability, (2) if and how this relationship differs when novelty is assessed at regional versus local spatial scales, and (3) how this mechanism differs between native and invasive species. We find a significant negative correlation between phylogenetic novelty and the effect of competitor reduction at both spatial scales tested, indicating that novel species are better competitors, though the relationship is driven mostly by native rather than invasive species. Our results increase our understanding of Darwin’s Naturalization Hypothesis because we are the first to show that novel species are more successful due to increased competitive ability. These results are consistent with many other studies that find a correlation between phylogenetic novelty and spread of invasive species, tapping competition as an important mechanism in invasion.

**Illness Narratives: A Look into the Experiences of Women in St. Louis on Medicaid Living with Breast Cancer-Related Lymphedema**
Gina B. Phillips
Mentor: Peter Benson

Breast cancer treatment is the number one cause of secondary lymphedema in the US. Due to the elevated incidence of breast cancer in St. Louis City and St. Louis County compared to state and national averages, incidence of Breast Cancer-Related Lymphedema (BCRL) is also likely elevated. While Missouri’s Medicaid program (MO HealthNet) provides full coverage for breast cancer treatment, this coverage does not extend to any BCRL treatment, including physical therapy and compression garments. This qualitative study aims to explore the illness narratives of women enrolled in MO HealthNet in St. Louis, living with BCRL. Semi-structured interviews were
conducted in-home using the phenomenology approach to understand the essence of the women’s experiences. Four shared themes were
determined by analyzing the significant statements of the participants: 1) Feeling emotionally, physically, and financially burdened by
BCRL, 2) Encountering multiple barriers to improving prognosis, 3) Believing physicians were not adequately helping patients deal with
BCRL, and 4) Arguing against Medicaid’s lack of coverage. More data is necessary to determine additional themes, but the narratives
thus far reveal the common plight of a particularly vulnerable group of women.

RELEASE FACTOR METHYLATION:
A MECHANISM FOR KINETIC UNIFORMITY IN TRANSLATION TERMINATION
William Pierson
Mentor: Hani Zaher

Protein translation, carried out by the ribosome, consists of four steps: initiation, elongation, termination, and ribosome recycling. While
the kinetics of initiation and elongation are well-characterized in relation to translation fidelity, the intricacies of termination are not as
well-understood. Termination of translation is mediated by release factors (RFs), which recognize and bind to mRNA stop codons and
facilitate the release of full-length peptides from the ribosome. To release the peptide from the ribosome, RFs catalyze the cleavage of the
terminal peptidyl-tRNA bond, which connects the C-terminal amino acid of the nascent peptide to its tRNA. There exists a universally
conserved tripeptide motif, GGQ, in RFs that plays a central role in their catalysis. The glutamine residue of the GGQ motif is thought
to be directly involved in positioning a water molecule in place to cleave the peptidyl-tRNA bond. In addition, this glutamine residue is
universally N5-methylated, which has been shown to stimulate the rate of termination. We show that GGQ N5-methylation of RF1 and
RF2 in E. coli substantially increases the rate of termination and increases kinetic uniformity among termination of peptides with varying
C-terminal amino acid residues. We propose that this acts to increase the fidelity of peptide release. Similar to quality control mechanisms
that mitigate instances of ribosome stalling during peptide elongation, this enables a more uniform process on the ribosome.

See Matthew Ayanian

OBAFLUORINE:
A POTENTIAL BETA-LACTONE INHIBITOR OF SERINE HYDROXYMETHYL TRANSFERASE
Neha Prasad
Mentor: Timothy Wencewicz

In the golden age of drug discovery, scientists turned to nature to find and emulate molecules with pharmacological activity. The beta-
lactam ring in penicillin has proven to be one of the most important classes of antibiotics of the last century. The molecule studied here,
obafluorine, was isolated from Pseudomonas fluorescens and has a beta-lactone ring in its structure—a close relative of the beta-lactam
ring in penicillin. Obafluorine was isolated as a broad-spectrum antibacterial and antifungal agent that could have therapeutic properties,
but its cellular target is still unknown. The Wencewicz Lab is studying the biosynthesis of obafluorine in order to understand how nature
enzymatically constructs the rare beta-lactone ring. Moreover, the mechanism by which a P. fluorescens bacterial cell defends itself from
the secreted toxic molecule is under investigation. The entire sequenced genome of P. fluorescens ATCC 39502 was searched for a putative
cluster of genes responsible for obafluorine production. A complete biosynthetic pathway was proposed, based on the predicted
enzymatic reactions of the gene cluster’s protein products. One enzyme identified in the Obi cluster is a serine hydroxymethyltransferase
(SHMT), which is involved in folate biosynthesis and linked to cell growth. Interestingly, the gDNA of P. fluorescens codes for 2 unique
SHMTs; one within (ObiH) and one outside of the Obi cluster, with significantly different amino acid sequences. These mutations alter
conserved binding sites of the ObiH enzyme, suggesting that ObiH could confer a new self-protection function. It is hypothesized that
obafluorine will not inhibit the mutated SHMT enzyme (ObiH) as severely as the wild type SHMT and allow the P. fluorescens cell to
proliferate. Obafluorine could be the first non-folate inhibitor of SHMT, and serve as an anticancer, antimalarial, and antimicrobial molecule.
A NOVEL PROTEIN PIF1A IS PIVOTAL FOR ACTIN CONE MOVEMENT DURING SPERMATID INDIVIDUALIZATION IN DROSOPHILA MELANOGASTER

Harrison Pravder
Mentor: Kathryn Miller

The cellular cytoskeleton is pivotal for cell-type specialization. Actin is one of the major modular proteins that makes up the cytoskeleton, and actin structures are extremely important for cell shape and organization, which vary in different cell types. Our lab uses the actin-mediated process of spermaticid individualization (SI) as a model for studying the role of actin in cell specialization. During SI, 64 syncytial spermaticids are segregated into individual cells; to accomplish this, 64 actin cones remodel the cells by moving synchronously from the spermaticid nuclei, along the sperm axoneme, to the tail ends. We screened an existing collection of male-sterile mutants to identify mutants with defects at this stage. We identified many mutants with interesting SI phenotypes, including Z3-5009. In homozygote male Z3-5009 mutants, actin cones form but do not move. Cytoplasmic microtubule degradation normally occurs prior to cone movement; in these mutants microtubules are not completely degraded, suggesting that progress to the stage of cone movement is blocked. Using next-generation DNA sequencing, we sequenced the genome of the Z3-5009 mutant and identified a SNP in the region that codes for the Pif1A gene. To test the hypothesis that Pif1A was the affected gene, we inserted a GFP-fusion Pif1A transgene into the mutant fly line. Fertility crosses were performed and showed that Z3-5009 males with a GFP-Pif1A transgene were fertile, confirming that loss of Pif1A function is causative of the phenotype. Actin cones in the transgene-rescued animals exhibited normal movement and proper degradation of microtubules, suggesting that providing the Pif1A protein fully rescued the mutant phenotype. We propose that Pif1A plays a pivotal role in actin cone movement, possibly as a signal to transition to the next step of SI, which includes microtubule degradation and initiation of cone movement.

Matt Puzder
See Ryan Gecci

GENE EXPANSION IN THE DROSOPHILA ANANASSAE F ELEMENT

Thomas Quisenberry
Mentor: Sarah Elgin

The Drosophila melanogaster Muller F element is a small autosome (~4.2 Mb) that is primarily packaged in a heterochromatic state. However, the distal 1.3 Mb of this autosome contains ~80 genes (including several essential genes) and the proper expression of these genes is important to the overall fitness of the organism. The D. ananassae F element is unusual because it is substantially larger (~20 Mb) than the F elements in the other Drosophila species. As a result of this expansion, some of the D. ananassae F element genes are much larger than their D. melanogaster orthologs. To elucidate the factors that enable F element genes to be expressed in a heterochromatic environment, we performed a comparative analysis of the genes found on the D. melanogaster and D. ananassae F elements. To facilitate this analysis, we improved ~1.4 Mb from three D. ananassae F element scaffolds and carefully annotated the twelve F element genes located therein. We analyzed these twelve genes along several parameters (e.g. GC content, codon bias) to identify factors that correlate with the size of the coding spans. Our analysis shows there is a strong correlation between coding span and intron size, which suggests that most of the changes in the size of D. ananassae F element genes can be attributed to the change in intron size but not to the size or the number of coding exons. However, we could not identify any other gene characteristics that show a strong correlation with the size of the coding spans. Furthermore, the study is limited by the small sample size. As we annotate more F element genes in future investigations, we can incorporate them into the analysis pipeline that we have developed to search for additional correlations among the different gene characteristics.

Rahul Ramaswamy
See Madeleine Mullon

EFFECTS OF TESTING AND ALTERNATIVES ON RETRIEVAL PROCESSES

Matthew Rantle
Mentor: Mark McDaniel

When evaluating the strength of memory, the retrieval of information is just as important as the coding of information. It has been well-proven that memory traces are strengthened by the retrieval process, and efforts have been made to decipher the most efficient retrieval methods. A wide variety of studies have provided empirical evidence for the mnemonic benefits of testing, which produces greater
improvements in memory compared to simply restudying information (Butler, Karpicke, & Roediger, 2008; McDaniel & Fisher, 1991; Pashler, Cepeda, Wixted, & Rohrer, 2005). However, no studies have broken down the specific processes that cause this improvement in recall accuracy after testing. The McDaniel Lab examined these underlying mechanisms and focused on two potential sets of processes; the front-end control process and the later retrieval process.

Retrieving information can improve one’s ability to recall that information later. The current experiments explore this idea by comparing the effects of testing verses restudy when participants are trying to learn facts. We explored the differences in memory retrieval on a final test. Specifically, we compared front-end control memory retrieval processes with later monitoring processes that prevent incorrect candidates from coming to mind. In this experiment, we used random trivia questions as a follow up to the cue-target word pair associates to determine if the previous results could be generalized to other type of learning; especially those that are closely related to classroom activities.

**EPIGENETIC REPROGRAMMING**

Ryan Rees  
Mentor: Grant Challen

The epigenome is the sum of all the chemical compounds added to the DNA-based genome and histone proteins of an organism in order to regulate gene expression. Global mapping of epigenetic markers have revealed that abnormal placement of these modifications play a role in a wide variety of diseases. Considering that epigenetic marks are additions to the DNA or histone structures that do not change their underlying structure, these marks have the potential to be altered. Although global remodeling strategies do exist, to this date no strategy for specific alteration of epigenetic marks has been proposed. We hypothesized that a catalytically inactivated CRISPR/CAS9 construct could provide the means to selectively reprogram regions of the genome and therefore cause changes in gene expression. Mouse N2A cells were transfected with a dead CRISPR/CAS9 construct with guide RNAs specific to the SNRPN gene region involved with alternate splicing of mRNA products and gene expression. This dCas9 construct was fused with TET-1, a demethylase that catalyzes the oxidation of 5-Methylcytosines to 5-Hydroxymethylcytosines. The transfected mouse N2A cells were sorted using fluorescence-activated cell sorting then subjected to bisulfite sequencing to analyze if demethylation occurred within the specific gene region of interest. Duplicates of the mouse N2A cell transfections were converted to cDNA and then changes in gene expression were analyzed through RT-PCR. Through bisulfite sequencing we found an approximately 9% change in methylation of the SNRPN gene region, from 74% methylated to 62.3% methylated. The RT-PCR revealed a roughly twenty fold change in gene expression in the SNRPN gene region and a nearly one-hundred-fold change in gene expression in its downstream target SNORD116. These results imply that we may be able to reprogram select regions of the epigenome and cause corresponding changes in gene expression.

**ISOLATION AND COMPARATIVE GENOMIC ANALYSIS OF MYCOBACTERIOPHAGE ENKATZ**

Micah Rickles-Young, Shaarada Srivatsa, Thomas Van Horn, Tina Zudock  
Mentors: Sarah Elgin and Kathleen Hafer

Phage Enkatz is a temperate mycobacteriophage isolated from an un-enriched soil sample collected from the path to the Delmar Loop on the Washington University campus. Enkatz displays unequally sized plaques with a clear center that become cloudier with radial distance from the center. Genome analysis indicates that Enkatz is a cluster A1 mycobacteriophage with a genome size of 49,738 bases and 82 identified genes, 33 of which have been assigned functions. This analysis reveals that the majority of the genes in the positive strand code for structural proteins, while the majority of the genes in the negative strand code for various functional enzymes or proteins of unknown function. Comparing Enkatz to Phages Museum and Solon (its closest genetic neighbors) reveals that the positive strand is more conserved than the negative strand. Interestingly, gene 43, which occurs in the negative strand, appears to be spliced into the genome from a non-host bacteria. In addition, the presence of a Beta-lactamase gene, which has been found to confer antibiotic resistance, suggests that Enkatz may act as a vector to transmit resistance to its bacterial hosts. Research into the Enkatz genome is important because there are 94 distinct A1 Mycobacteriophage, and the minor differences between them can build a picture of phage evolution and how genes are transferred between bacterial hosts.

**WHAT THE HELL WAS FERGUSON:**

**A PEOPLE-CENTERED APPROACH TO THE SOCIAL MOVEMENT THAT TRANSFORMED ST. LOUIS**

Reuben Riggs  
Mentor: Bret Gustafson

This research outlines a people-centered approach to understanding the Ferguson movement. It explores the way protestors interpreted and produced meaning within the various spaces they entered. It uses an academic-activist approach and ethnographic methods including participant observation, interview, and content analysis to paint a picture of this experience. First, we argue that an intersectional
grounding informed the way people operated within Ferguson. We examined the intersections of race, gender, class, and sexuality to
highlight how people and the movement produced knowledge, transformed subjectivities, and developed praxis. Next, we looked at how
movement actors used a ‘generational divide’ discourse to understand abstract ideas about the movement and their agency within it. By
discussing the different approaches of ‘older’ and ‘younger’ generations, people defined the movement, navigated political ideologies,
shaped modes of operation, and categorized other participants. Finally, through a narrative about the group St. Louis Students in
Solidarity, we suggest a process of reflecting on power within the movement. By first telling the story and then offering analysis, it
outlines the many ways protestors grappled with their position within larger systems and conceptualized their ability to affect those
paradigms. We address these three meaning-making concepts - intersectionality, generational divide, and power – as a group in order to
insert people into a broader movement narrative that weaves together identities, generational tensions, and means of effecting change.
The result provides a fuller understanding of the meanings produced by movement participants, and more broadly, provides a space of
reflection for Ferguson participants.

STUDIES OF MITOCHONDRIAL-ASSOCIATED PROTEINS IN *TETRAHYMENA THERMOPHILIA*

George Rizk and Sarabjeet Seehra
Mentor: Douglas Chalker

Mitochondria are vital organelles, which serve as major energy sinks for many organisms and interface for protein transport and protein
regulation with the cytoplasm. They have their own set of translated proteins as well. *Tetrahymena thermophila* is good eukaryotic model
organism to use to better understand processes such as protein translation and apoptotic pathways in mitochondria. Two genes in the
*Tetrahymena* genome, called *Tetrahymena GrPE 1* (TGrPE1) and *voltage dependent anion selective channel 4* (VDAC4) may have important
roles in such mitochondrial processes. TGrPE1 encodes for a protein product whose eukaryotic orthologs facilitate the exchange of ADP
for ATP on proteins involved in proper protein folding, such as Hsp70. VDAC4 encodes for a porin trans-membrane protein, whose
orthologs, such as VDAC1 and Tom40, are involved in communication among organelles and trans-membrane transport. Evidence gathered
from bioinformatics analysis and protein localization studies support VDAC4 and TGrPE1 involvement in mitochondrial processes. To
better understand the dynamics of these proteins in the mitochondria and their interactions with other organelles, we formed a YFP
protein fusion construct to determine protein localization, along with co-localizing and staining both proteins. The potential insights
possible from our results can be valuable in understanding cell life-and-death cycles, as well as protein folding and trafficking.

McKenna Rogan
See Ji Hyun Ahn

**DAVID, JOSIAH, AND HENRY VIII:**
**POLITICS OF REFORMATION KINGSHIP IN THE IMAGE OF THE OLD TESTAMENT**

Samantha Rogers
Mentor: Christine Johnson

Our research traces the development of Old Testament kingship as a political language in the time of Henry VIII, and the role it played
in the emerging discourse on ecclesiastical and secular authority. Biblical language pervaded political and religious discourse in early
modern England. With the Reformation, the Bible came to serve as the sole uncontested source of religious truth and the Old Testament
took an increasingly central role in the language of political debate. An examination of the choice of biblical models and their functions
reveals the shifting landscape of biblical hermeneutics in the English Reformation, together with the change in traditional conceptions
of kingship. The use of Old Testament models shifted in purpose, developing from medieval devices of royal flattery into tools through
which counsel might be offered. Parallels with biblical kings, particularly David and Solomon, were not an uncommon means of
flattery by sixteenth century England. This model had continued under Henry VIII, albeit with slight revisions to stress the divine and
sacral nature of the king, until it had become a staple of iconography. However, the cast of Old Testament characters was used to different
ends by reformers, who offered different biblical monarchs as their ideal, putting forth reformational kings such as Josiah and Hezekiah,
along with David and Solomon. The model of Old Testament kingship continued following the death of Henry VIII, as both the number
of biblical models and their frequency in political discourse increased into the Stuart era. By looking at a range of visual and textual
sixteenth century sources, this research offers a nuanced view of the politics of early English Reformation authority and the way in which
Old Testament kingship informed it.
SYNCING UMBANDA AND SCIENCE (SUS):
USING UMBANDA’S HOLISTIC HEALING METHODS TO INCREASE ACCESS TO HEALTHCARE
Alex Rosenthal
Mentors: John Bowen and Peter Benson

In 1988, after the 1985 termination of the military dictatorship in Brazil, the constitution was rewritten to guarantee individual rights to all citizens of Brazil. Among the various other rights that the new constitution protected, anyone in Brazil was granted the right to government-funded healthcare under the regulation of the Unified Healthcare System, SUS. Because of structural inequalities in Brazil as well as the rise of privatized healthcare, equal access to healthcare is not a reality in modern-day Brazil. Many citizens who live on the periphery are limited to understaffed and underfunded primary health centers.

This research explores the healing methods that are intrinsic to the Afro-Brazilian religion, Umbanda, and the connections that are being made between Umbanda and SUS in the attempt to improve universal access to healthcare. Through interviews, observations, and ritual participation, I look at past, present, and future healthcare programs that involve the bidirectional flow of healthcare knowledge between Umbanda centers and health centers. The research concludes that integrating holistic, traditional healing into the conventional biomedical system has the potential to improve the quality of healthcare for all citizens. I theorize that this potential is limited by the heavy stigmatization and marginalization of the populations that develop these treatments and lack of continuity of program development as a result of government structure. The topic is then contextualized within the larger framework of healthcare in Brazil through a discussion of João Biehl’s research on the Brazilian AIDS initiative.

INFLUENCE OF DICTYOSTELIUM DISCOIDEUM UPON CHEATING WITHIN PSEUDOMONAS FLUORESCENS
Erica Ryu
Mentors: Joan Strassman and David Queller

Cooperation and competition are social behaviors that are essential in evolutionary biology because they drive certain species to thrive while others are pushed towards extinction. Such interactions have been primarily observed in macroorganisms, but recent studies show that these associations are present in microorganisms. The interactions between Pseudomonas fluorescens and Dictyostelium discoideum exemplify social evolution in the micro setting. P. fluorescens is one type of food bacterium that the amoeba, D. discoideum, may carry when migrating to a new environment. Two strains of this bacterium were recently discovered in the same environment. One strain, the cooperator, produces siderophores, particles that seek iron for the host in iron-deficient environments. The other strain, the cheater, does not, yet they still absorb siderophores. Experiments with Pseudomonas aeruginosa, a bacterium that also exhibits this type of cheating, show that the cheaters outcompete the cooperators because they have more energy to grow. The strains of P. fluorescens, however, coexist in nature, contradicting the experiments with P. aeruginosa. I hypothesize that D. discoideum influences the populations of the strains, which is why the cheaters do not outcompete the cooperators. P. fluorescens strains would first compete against each other to affirm the cheater-cooperator relationship. Then, they would compete in the presence of D. discoideum. After competition, the cultures would be spread on plates and the colonies of each strain would be counted, each strain tagged with a different fluorescent marker for differentiation. If the predictions were supported, then it would confirm D. discoideum’s evolutionary role in P. fluorescens. These observations would show that competition and cooperation are social concepts applicable to not just macroorganisms, but to microorganisms as well, thus emphasizing that social evolutionary theories are universal ideas. If not, then more experimentation must be completed in order to determine how the cooperators survive.

INDIVIDUAL DIFFERENCES IN HEDONIC CAPACITY, DEPRESSED MOOD, AND AFFECTIVE STATES PREDICT EMOTIONAL REACTIVITY
Abhishek Saxena
Mentor: Deanna M. Barch

Emotional reactions to stimuli in the environment are critical to our understanding of the world and our perceptions and memories. Identifying the factors that contribute to inter-individual differences in emotional reactivity is central to understanding the basic mechanisms that give rise to adaptive emotion reactivity, as well as the disruptions in these mechanisms that can lead to psychopathology. The current study examined relations between three individual difference factors relevant for understanding mood pathology – anhedonia, depressed mood, and current affective state -- and emotional reactivity in a non-clinical sample. The emotional reactivity of participants (N = 101) was assessed using an Emotional Picture Rating Task (EPRT). During the EPRT, participants rated the valence and arousal level of their emotional responses to 100 pictures (40 negative, 20 neutral, and 40 positive pictures) from the International Affective Picture System. Participants also completed self-report questionnaires assessing hedonic capacity, general affect, depressive
symptomology, and current affective states. We found that reduced hedonic capacity predicted blunted emotional reactivity to both positive and negative pictures, while elevated depressed mood predicted potentiated emotional reactivity to negative pictures. Further, affective states showed effects beyond those of anhedonia and depressed mood. Specifically, a positive affective state predicted potentiated positive emotional reactivity and a negative affective state predicted potentiated negative emotional reactivity. The current study builds on prior literature by showing that different individual difference factors relevant to emotional function and mood pathology (i.e. anhedonia and depressed mood) can have separable effects on emotional processing, even in a non-clinical population.

**Planning Abilities of Wild Chimpanzees (Pan troglodytes troglodytes) in Tool Using Contexts**

Carley Schleien
Mentor: Crickette Sanz

Planning is a type of problem solving in which an appropriate course of action for the future is devised by means of mental computation. Advantages of such skills in tool use include conserving effort in gathering tools, achieving closer alignment to an efficient tool design, and increasing foraging efficiency. Chimpanzees (Pan troglodytes troglodytes) in the Goualougo Triangle use several tool types to harvest termites, including fishing probes, puncturing sticks, and perforating twigs. Planning behavior associated with different tool types has not previously been examined in detail. We hypothesized that method of procurement (i.e., brought to the termite nest, gathered at the nest, or borrowed from others) differed by tool type. Also, we predicted that certain tool types were more likely to be transported in multiples than others. Twenty-five hours of video recording chimpanzee visits to termite nests were systematically screened for tools (>1,100 events) and the procurement of these artifacts. Most tools brought to nests were fishing probes, which are manufactured from herbaceous material and typically used during a single visit. In contrast, a higher relative proportion of wooden puncturing tools were acquired at the nests. Tools transported to nests in multiples were most often fishing probes, perhaps in anticipation that a single probe might not be viable throughout an entire foraging bout or might be transferred to another chimpanzee. Mature chimpanzees brought tools to nests more often than did immatures. The next step in this research is to conduct broader comparative examinations of planning in the wild.

**Investigating the Importance of the Metalloprotease Falcilysin in the Human Malaria Parasite, Plasmodium falciparum**

Maria Schletzbaum
Mentor: Daniel Goldberg

In 2010, the World Health Organization estimated that there were 219 million cases of malaria worldwide, yet resistance has been verified for all but one drug treatment. Consequently, new drug targets and drugs are needed. Protease inhibitors targeted at HIV have been shown to decrease malarial infection in patients. The P. falciparum metalloprotease, falcilysin, is expressed in all growth stages when 1) the parasite is in the blood, 2) is found in several cellular locations, and 3) has two conformations and peptide specificities depending upon local pH. Falcilysin seems to be a promising drug target. The essentiality of the protease and the role and importance of its two conformations and various cellular localizations is still unclear. Active-site point mutations were made of the parasite and have produced viable populations (previous truncations of the protein did not produce viable parasites). Mutant, wild-type, and control falcilysin will be collected and purified. Kinetic analysis will be run at both ideal pHs to determine if the mutations affect the protease’s catalytic ability or specificity and, if so, if the difference is greater for one conformation over another. Finally, growth analysis will be run to determine if catalytic changes translate into phenotypic growth changes.

**Civilizing Combat: The American Laws of War in the Philippines, 1899-1902**

Sonya Schoenberger
Mentor: Elizabeth Borgwardt

After the December 1898 Treaty of Paris transferred control of the Philippine Islands from Spain to the United States, the U.S. Army spent three years “pacifying” nationalist resistance to American rule across the archipelago. Between 1899 and 1902, the Philippine-American War claimed the lives of 6,000 American soldiers and 250,000 Filipinos—most of these civilians. This project examines the ways in which the laws of war facilitated the United States’ destruction of the Philippine Republic. While American democratic principles and humanitarian pretensions precluded the adoption of an overt policy of conquest and extermination, the laws of war endowed the U.S. Army with broad license for violence by classifying Filipinos as non-sovereign and “savage,” and thus beyond the protections accorded
“civilized” belligerents. As the Filipino nationalists transitioned from conventional to guerrilla tactics, consciously departing from the laws of “civilized” combat in a final effort to save their country, the U.S. Army adopted policies that classified virtually every Filipino as “hostile” and therefore an appropriate target of violence. We analyze the 1901-1902 campaign on the island of Samar and the court-martial of General Jacob H. Smith and Major Edwin F. Glenn as two detailed examples of the fraught legal and moral boundaries of American violence against Filipinos. Both General Smith and Major Glenn invoked the laws of war, as embodied in General Orders No. 100, as justification for tactics of total warfare against all Filipinos deemed hostile to the American presence. The legal framework that guided the U.S. Army’s campaign in the Philippines fatally classified Filipinos as both subjects of uplift and appropriate targets of violence, and ultimately endowed American officers with broad interpretive license to translate racial animus into exterminatory campaigns in the name of freedom, democracy, and durable peace.

Sarabjeet Seehra
See George Rizk

Predicting the Power Load Profile and Solar Resource
David Sehloff and Celso Torres
Mentor: Arye Nehorai

The value of solar energy is recognized for a variety of reasons, such as environmental and public health and security of supply. Inherently associated with these sources, however, is a degree of uncertainty. It would be advantageous to know a day in advance how much power renewable sources will deliver, along with how much power will be demanded. This would help suppliers determine the type and quantities of other resources to use. The goal of this research is to build predictors for both the power load and the solar resource. These predictors are built with the machine-learning technique known as support vector regression. Using weather, solar, and power-load data from several years, the support vector algorithm builds a predictor model that outputs day-ahead predicted power load and solar resource based on weather predictions. This allows analysis of the net power demands on the other sources of electric power for various levels of penetration of photovoltaic installations. The points of analysis for this net power demand include the maximum net power demand for each day and the maximum rate of increase of net power demand. The location chosen for this analysis comprises most of Oregon and Washington and parts of Idaho and Montana. The results of this analysis could be used by utilities or balancing authorities to plan which power plants should run at certain times and when energy storage or demand-shifting incentives should be utilized.

Avoiding Common Ground:
The Politicization of the Common Core State Standards
Daniel Selzer
Mentor: Eileen G’Sell

Rarely has an education initiative caused so much political controversy nationwide as have the Common Core State Standards. Often labeled by opponents as another example of the federal government encroaching on states’ rights, the development and adoption of Common Core has, in reality, been much less controversial. Created by a commission organized by the National Governors’ Association - completely independent of the federal government - the Common Core arose from a need to improve America’s education system and hold all American children to the same educational standards. Adopted by 43 state legislatures, the connection to the federal government comes from President Barack Obama’s Race to the Top funding competition, in which states that adopt new curricula can apply for a chunk of $4.3 billion in federal funding and adopting Common Core guaranteed this funding. Our research looked at the involvement of other independent players involved in Common Core. British education official Michael Barber, the Bill and Melinda Gates Foundation, and the College Board and ACT have all been heavily involved in the Common Core State Standards. Even if their intentions are good, none of these entities are elected officials, yet they are deciding what American children should and should not learn. The last major issue with the Common Core has been the failure to create tests that align with the standards. Our research determined the need to curb the detrimental effects on students taking unproven tests and teachers whose careers depend on the scores. A real discussion is needed about the benefits and detriments of the Common Core State Standards, but hyperbolic campaign ads and fiery political speeches that fail to acknowledge the actual history of the Common Core are not accomplishing that.

Adam Seroka
See Sonya Anderson
ANTHROPOLOGY OF THE FIRST PUFF:
AN INQUIRY INTO THE BEGINNINGS, CULTURES, AND CONTEXTS OF TOBACCO USE
IN STUDENTS AT WASHINGTON UNIVERSITY IN ST. LOUIS

Kristoffer T. Sladky
Mentor: Peter Benson

Cigarette smoking is widely recognized as the leading cause of preventable mortality in the United States, accounting for more than 480,000 deaths per year. Although smoking rates in adults have steadily declined over the past twenty years, smoking among college students has risen sharply. The objectives of this study were to: 1) explore the contexts within which individuals in a particular population smoke a cigarette for the first time; 2) examine how these contexts and perceptions of smoking contribute to the smoker’s future habits, and 3) determine whether any novel circumstantial factors exist that increase one’s risk for initiating smoking behavior. Quantitative data were collected from students (n=59) using surveys, and qualitative interviews (n=9) were conducted on the Danforth Campus of Washington University in St. Louis. Contexts addressed in the surveys and interviews included, but were not limited to, alcohol consumption, stress, social smoking, regret, parental influence and current smoking habits. Results countered the current literature which suggests that college students begin smoking before they arrive on campus and support the assertion that smoking cigarettes is strongly associated with alcohol consumption among college students. In addition to corroborating associations of cigarette use with stresses of college life and partying, results of follow-up interviews revealed novel social factors, including “coolness,” gender and attraction, and studying abroad, which may increase one’s risk of initiating, and establishing smoking habits during college.

THE CHANGING ROLE OF PLANT-SOIL FEEDBACK LOOPS
IN MAINTAINING COEXISTENCE IN THE FACE OF DROUGHT

Amelia Snyder
Mentor: Scott Mangan

The goal of this research was to explore the influence of drought and soil biota on plant growth via plant-soil feedbacks, and thus to examine potential implications for stable coexistence for similar plants within overlapping species ranges. I carried out a greenhouse experiment to determine the effect of drought and soil biota on the relative fitness of two milkweed species. The project consisted of harvesting soil samples of each species from the field, further training the soil in the greenhouse to cultivate soil organisms, then growing each milkweed species in trained soil in a fully reciprocal experiment that included watering regimen and soil biota as treatments.

There were strong conspecific negative feedbacks in both species, but these diminished under drought treatments. These results were driven by the growth of below-ground biomass and were likely due to an increase in pathogenic soil microbes cultivated on the roots of conspecific plants. However, conspecific soil allowed for more growth in Asclepias syriaca compared to Asclepias sullivantii, suggesting that A. syriaca is less limited by pathogens. Additionally, these negative effects disappeared in treatments where the inoculum was sterilized.

Findings suggest that biotic soil interactions play a significant role in plant growth, which complicates the possibility of coexistence in plants with overlapping ranges beyond resource competition. As drought intensifies under climate change, the effect of drought on soil-feedback mechanisms will complicate future range predictions beyond the physiological stresses of the drought-intensive summers predicted by climate change models, requiring an increase in knowledge of plant-soil interactions so that future ranges can be more accurately predicted.

Ricardo Solis
See Ji Hyun Ahn
INFLUENCE OF FEBRILE AND PHYSIOLOGICAL TEMPERATURE ON HELPER T-CELL CYTOKINE OUTPUT
Arvind Srinivasan
Mentor: Daniel Hanson

Many explanations have been offered as to the role of fever during the course of an immune response. Fever in response to infection is a phenomenon that is conserved near-universally in vertebrate organisms, yet little is known about how exactly fever contributes to host defense and the responses of the immune system. Previous research has shown that different physiological temperatures have a range of effects on immune responses modeled in vitro. This research aims to define how different physiological temperatures affect the cytokine output of helper T-cells, particularly whether or not different cytokines are differentially expressed at temperatures that fall within the clinical definition of “fever.” In particular these experiments ask whether the prior thermal experience of the cells during initial activation can shape their cytokine output upon restimulation at a single temperature. To this end the supernatants of these samples will then be analyzed using a multiplex flow cytometry to quantify multiple cytokines. Preliminary results suggest that at febrile temperature, the cytokines expressed by the Th2 line of helper T-cells are preferentially expressed. Further research into this field might contribute to knowledge of how the adaptive immune system tailors its response to specific pathogens and how it may shape the memory response of the adaptive immune system.

Shaarada Srivatsa
See Micah Rickles-Young

REVISITING THE YOUNGEST MARE BASALTS ON THE MOON: ANALYSIS OF PRIMARY AND SECONDARY CRATER DISTRIBUTIONS IN THE REGION SOUTH OF ARISTARCHUS CRATER
Amanda Stadermann
Mentor: Bradley Jolliff

The mare south of Aristarchus Crater was dated using crater-size frequency distribution (CSFD) by Hiesinger et al. (2003) to be 1.2 Ga. Since this region is a potential site for future sample return missions and is heavily contaminated by secondary cratering from Aristarchus, we investigated to better define this age and how it varies across the unit. By separating primary craters from obvious secondary crater chains, we were first able to match the age found by Hiesinger et al. (2003). By separating out secondary craters from primary impacts, we created a CSFD of the entire unit. We found that there are two ages represented by this unit: a younger 1.82 Ga flow on top of a 3.58 Ga flow. This resurfacing of the mare is evident from craters of about 2 - 3 km diameter that appear to be embayed by this younger lava flow. There are also ghost craters of similar size, just barely covered by the flow so their rims are still present. There are several small volcanic vents in this unit that are possible sources for this younger flow.

Leslie Sterling
See Madeleine Mullon

PERSONALITY AND HEALTH: AN ASSESSMENT OF HEALTHY NEUROTICISM
Kelsey Stiles
Mentor: Joshua Jackson

Personality traits have been linked to health behaviors and health status in a multitude of past studies, but few have examined the effects of personality-trait interactions. The present study used an online questionnaire to assess how healthy neuroticism, the co-occurrence of high levels of conscientiousness and neuroticism, is related to health. Participants provided information about their health-related thoughts, feelings, and behaviors, and the responses of participants who had high levels of both traits were analyzed to identify what makes these individuals distinguishable. The results provided four main findings. First, healthy neuroticism, as defined by high levels of conscientiousness and neuroticism, is relatively rare. Second, though many constructs were associated with healthy neuroticism, they had stronger associations with the independent traits of conscientiousness and neuroticism. Third, the results indicate that for this particular sample, the individual traits were more indicative of health than was the interaction between them. Fourth, more specific levels of personality were not able to uniquely identify healthy neurotics. Overall, while healthy neuroticism is theoretically plausible, it is difficult to identify the health behaviors that distinguish these individuals from non-healthy neurotics. These findings lead to new questions about how personality-trait interactions affect health.
DIRECT CHEMICAL VAPOR DEPOSITION OF BISMUTH OXYCHLORIDE THIN FILMS ON TRANSPARENT CONDUCTIVE OXIDE ELECTRODE
Andreea Stoica
Mentors: Parag Banerjee

Bismuth Oxychloride (BiOCl) is a wide band-gap semiconductor with potential applications in energy storage, catalysis, and gas sensing due to its unique electrical, optical, and catalytic properties. The purpose of this project was to study the growth conditions of BiOCl thin films through chemical vapor deposition. BiOCl thin films were deposited on ITO coated glass substrates while varying the growth conditions such as precursor temperature in the range of 300 °C to 700 °C and flow rate in the range of 100 sccm to 300 sccm. The obtained films were characterized using scanning electron microscopy, Raman spectroscopy and X-ray photoelectron spectroscopy. A dependence of the film structure to the precursor and substrate temperature was observed.

COMPUTING THE DISPERSION RELATION OF PERIODIC QUANTUM GRAPHS
Alan Talmage
Mentor: Renato Feres

We present methods of Kuchment and Post for calculating the dispersion relation of periodic quantum graphs and reformulate them in terms of a matrix-valued function on such graphs. We show how this leads to simpler methods for computing the dispersion relations for many periodic quantum graphs. We also reduce the computation of the dispersion relation for a periodic extension of an undirected Cayley graph of a finite group to finding the eigenvalues of the adjacency matrix of the undirected Cayley graph of the finite group.

THE TEA PARTY MOVEMENT:
A DEMOCRATIC UPRISING OR MANUFACTURED DISSENT?
Jolijt Tamanaha
Mentor: Randall Calvert

Social movements play a crucial role in American democracy. They are the means by which a group of people band together to challenge the elite perspective, restructure power, and shape America’s government. When the Tea Party won 45 seats in Congress in 2010, they declared themselves a successful social movement and many agreed. Some scholars, politicians, and journalists, however, have argued that the Tea Party should instead be understood as a conservative arm of the Republican Party or as people manipulated by lobbyists into fighting for pro-business polices.

This research looked at patterns in rhetoric to evaluate the extent to which the Tea Party is a social movement. I collected 99,452 blog posts, moments of speech, and transcripts from the Tea Party, Republican party, lobbyists, and conservative media. I first looked at the origins of the phrases that the Tea Party uses with “statistically improbable” frequency. The vast majority of their phrases were first used by the conservative media. That suggests that many of their ideologies stem from the conservative media, which is closely connected with and reflects the views of established elites; in that sense, the Tea Party is not a social movement. However, when the prevalence of topics discussed by the Tea Party, Republican party, lobbyists, and conservative media are tracked over time, it becomes clear that the Tea Party exhibits a certain autonomy. They focus on certain themes to a far greater extent than do any establishment groups. They discuss topics at their own pace, which means they are actively deciding what to focus on and are promoting their own ideologies in doing so. Therefore, while the Tea Party began as a manifestation of an existing arrangement of power, it evolved into a legitimate social movement.

HUMAN-MACHINE INTERFACE:
MYOELECTRIC CONTROL SCHEME TO RESTORE UPPER EXTREMITY MOTOR FUNCTION
Yuni Teh
Mentors: Arye Nehorai and Ed Richter

In human motor control, muscle synergy refers to the pattern of muscles that are coactivated to produce a movement. People with neurological conditions such as stroke or peripheral nerve injury may have loss of upper extremity muscle function that prevents them from performing essential arm movements. However, some degree of synergy is preserved in muscles that can be innervated. This work attempts to utilize these patterns in patients with upper extremity disabilities to control a human-machine interface that restores arm function. The human input of the system is the electrical activity, or electromyogram (EMG), of five shoulder muscles: the biceps, trapezius, pectoralis major, infraspinatus, and triceps. We designed a five-channel electromyogram (EMG) amplifier circuit using one INA118 instrumentation amplifier and two TL072 operational amplifiers with a high pass cutoff frequency of 20Hz and a total gain of 2000. This gain may be adjusted based on the subject’s muscle strength. We build a linear discriminant analysis (LDA) classifier in
MATLAB to distinguish five movements: biceps contraction, shoulder elevation, shoulder protraction, shoulder retraction, and triceps contraction. We then interface this with a robotic arm to trigger one action per shoulder movement. To minimize accidental actuation of the device, we specify the decision boundary threshold so that an action is only called when there is at least a 99% probability of movement and at most a 0.1% probability of non-movement. With a data set of 50 trials per movement, we performed a 100-fold cross-validation test of the LDA classifier using 30 random trials as training data and the remaining 20 trials as testing data. The results show that our classifier has a false positive error rate of 0.19% and a false negative error rate of 9.08% for a total error rate of 9.27%.

Celso Torres
See David Schloff

RECONSTRUCTING A CLASSICAL KITHARA
Joshua Trosch
Mentor: Timothy Moore

This research sought to reconstruct a classical kithara, an ancestor of the modern guitar popular in Greece during the 5th and 4th centuries BCE. The kithara was a more ornate, professional version of its cousin the lyre, requiring years to master and a high level of expertise to build. No archeological remains of the classical kithara have been recovered. Therefore, there is considerable debate amongst classical scholars over the details of its construction, notably the placement of the crossbar and shape of the body. A faithful reconstruction aims to resolve these points of contention, providing insight into both how this instrument sounded and how it was played. To this end, this research contrasts a visual analysis of depictions on ancient coins, vases, and reliefs with the foremost theories on the instrument’s construction found in contemporary, scholarly literature. Theories with both the greatest evidential support and with the greatest bearing in practical luthiery inform the reconstruction. This research suggests that the classical kithara was more structurally complex than what modern reconstructions have taken it to be. The instrument utilized a system for rapid pitch change and possessed a highly ergonomic body shape.

Darby Turner
See Tiffany La

Thomas Van Horn
See Micah Rickles-Young

OXYTOCIN RECEPTOR (OXTR) GENOTYPE (rs1042778) PREDICTS INDIVIDUAL DIFFERENCES IN THREAT-RELATED AMYGDALA REACTIVITY IN YOUNG MALES
Bianca Vannucci
Mentor: Ryan Bogdan

The neuropeptide oxytocin (OT) has been associated with psychopathologies characterized by social dysfunction such as anxiety and aggression. Pharmacologic administration of OT attenuates amygdala reactivity to threatening stimuli in males only, providing a plausible neurobiological mechanism that may contribute to sex differences in anxiety and aggression. The T-allele of rs1042778 within the oxytocin receptor gene (OXTR) has been linked to blunted OT plasma levels and reduced pro-social behaviors. Here we examined the role of rs1042778 genotype in conferring sexually dimorphic effects on amygdala reactivity (BOLD fMRI during a face-matching task) in young adults (whole sample: n=656 and European-Americans: n=312) participating in the ongoing Duke Neurogenetics Study. Consistent with the literature, our results show an interaction between sex and genotype on amygdala reactivity (WS: ΔR²=.0073, p=.0277; EA: ΔR²=.0158, p=.026); male T-allele carriers had relatively increased amygdala reactivity to threat-related stimuli (WS: p=.042; EA: p=.049), while there was no relationship between genotype and amygdala reactivity in females (WS: p=.39; EA: p=.23). Ultimately, these results suggest that this polymorphism confers sexually dimorphic effects on amygdala reactivity, which may have important implications for psychiatrically-relevant phenotypes such as socialization, aggression, and anxiety.
VISITOR EFFECT ON CAPTIVE WHITE-FACED SAKI MONKEYS AND GOLDEN LION TAMARINS
Anna Villanyi
Mentor: Amanda Melin

The purpose of this research is to assess how visitor presence affects the space use and behavior of two primate species in captivity. This study was conducted at the St. Louis Zoo on an indoor mixed-species group of four white-faced saki monkeys (*Pithecia pithecia*) and two golden lion tamarins (*Leontopithecus rosalia*). Scan sampling at five-minute intervals was used to record the height, distance from glass, and behavior of each animal as well as the number, volume level, and interaction level of human visitors. The number of visitors was highly correlated with the sound level in decibels ($\rho = 0.66$, Spearman correlation, and with the interaction level ($T = 0.72$), Kendall’s Tau-b. This suggests that the number of visitors can be used as an indicator of overall visitor invasiveness to study the effects of visitor presence. Decreases in resting behaviors were linked with increasing visitor intensity ($p=0.023$) for the group, which could be indicative of stimulating effects of visitor presence. Stimulation in a generally unchanging captive environment can be enriching, but in excess could also have negative stress-linked effects. The saki monkeys showed an increase of use of the highest spaces with increasing visitor presence. Species-specific differential response may indicate greater sensitivity to visitor presence in saki monkeys than in tamarins. However, the results for tamarins could also be confounded by the small sample size of two individuals, one of which was hand-reared and shows more human-centric behavior.

GIFTED EDUCATION TRIGGERS INTENSITY IN STUDENTS
Courtney Vishy
Mentor: Victoria Thomas

Students with high intellectual capabilities, among other characteristics, are identified and labeled as gifted. The education system has attempted to accommodate these students and their academic potential by implementing gifted education programs. These programs have created additional classroom environments equipped with many resources to encourage students to pursue challenges in areas of their own interest. However, this type of enrichment does not address all aspects of giftedness. The positive connotation of giftedness implies many positive characteristics, but there are also many negative consequences that cannot be disregarded. This includes strong affective memories, overexcitabilities, and unique development, which combine to create a powerful intensity in gifted students. These psychological abnormalities need to be incorporated into gifted education to provide students with an education best suited to their needs. This can be accomplished by training mentors within schools and creating a system of individuals to work as a dedicated team. In order to bring about this change, society must first reconsider the label of “gifted” and find an alternative that better encompasses all features of giftedness.

VEDOLIZUMAB EFFICACY AND SAFETY IN A TERTIARY CARE IBD CLINICAL PRACTICE
Emily Vivio
Mentor: Matthew Ciorba

Vedolizumab is a humanized monoclonal antibody that inhibits leukocyte vascular adhesion and migration into the GI mucosa by specifically blocking the $\alpha_4\beta_7$ integrin. This agent was recently approved to treat moderate to severe Crohn’s disease (CD) and ulcerative colitis (UC) in patients who failed at least one conventional therapy. Our aim was to prospectively assess the clinical use patterns, performance and safety of vedolizumab in an inflammatory bowel disease (IBD) referral practice. In this all patients beginning vedolizumab for IBD were prospectively enrolled if they provided informed consent. Assessments were made during infusion center visits at weeks zero, two, six and 14 and included basic laboratories, serum biomarkers (ESR and CRP), the short inflammatory bowel disease questionnaire (SIBDQ), and a complete medical history and physical exam. A partial Mayo score was calculated for UC patients while the Harvey Bradshaw index (HBI) and CDAI were calculated for CD patients. Paired Students T-test was used to determine significance. Of 42 eligible patients to date, 18 CD and 15 UC patients participated. Eleven CD and 13 UC patients had completed at least though week six. All, except for one UC patient, had previously received anti TNF$\alpha$ therapy. Immunodulators (IMM) were concurrently prescribed in 69% of CD and 67% UC patients. Summarily in CD patients, vedolizumab treatment led to significant reductions in CDAI (week six) and HBI (weeks two and six) and a trend was observed in the SIBDQ (week six). In UC patients, SIBDQ and partial Mayo scores were both improved at week six. No infusion reactions were noted. Two UC patients went to colectomy before the third infusion due to ongoing severe disease activity. Vedolizumab was well tolerated and led to improvements of both disease activity scores and quality-of-life measures by week six, but not traditional serum biomarkers of inflammation.
INTRODUCTION TO A KINDA BABOON (PAPIO KINDAE) STUDY SITE AND STUDY GROUP

Emily R. Walco
Mentor: Anna Weyher

The Kasanka Baboon Project was initiated in July 2010 to investigate the yet unstudied Kinda baboon (Papio kindae) in its natural habitat. A wild group of Kinda baboons in Kasanka National Park, Zambia was habituated over a six-month period. Formal data collection began in January 2011 and continues through to the present.

Environmental data including rainfall, temperature, and humidity is collected year-round to illustrate the interaction between the baboons and their habitat. Behavioral data is also collected year-round and demonstrates female philopatry with a linear dominance hierarchy between females and a much less structured hierarchy among non-natal adult males. Similar to other studies of baboons, the group spent on average 10% of their time in social activity; however, unique from other female-bonded baboon species, the Kinda females spend a significantly larger proportion of time in social interactions with males. GPS and scan data provide insight into the baboons’ diet, movement patterns, day range, home range, and habitat use. From the data on potential available habitat, one would expect the group to spend 36% of their time in grassland and 27% of their time in Miombo woodlands. Instead they show a clear preference for woodlands, spending only 1% of their time in grasslands and 54% in woodlands, making Kindas a Miombo woodland baboon quite different from other savannah species.

These findings demonstrate the vast differences between Kindas and other baboon taxa and lay groundwork for further study topics, including male-female relationships, infant development, and male-interactions.

CHANGES IN DIET COMPOSITION AND LIVER FAT IN YOUTH PARTICIPATING IN A BEHAVIORAL WEIGHT LOSS INTERVENTION

John Wang
Mentor: Ginger Nicol

The prevalence of cardiovascular risk factors like childhood-onset obesity and type-2 diabetes has increased in the United States in recent decades. Children with mental illness, especially those treated with antipsychotic medications, may have even higher risk for obesity and related risk factors. Hepatic triglyceride content (HTGC) measured by 1H Magnetic Resonance Spectroscopy (MRS) and adiposity measured by dual energy X-ray absorptiometry (DEXA) are well-validated metabolic risk measures. However, there is little study of how dietary interventions affect these markers in youth.

Study participants were overweight (BMI%ile 85-94) or obese (BMI%ile >95) antipsychotic-treated youth (n = 6) and healthy controls (n = 4) ages 6-19 from an ongoing pilot study of a family-based behavioral weight loss program. Subjects underwent 16 weeks of treatment using the Traffic Light Diet, which classifies foods as red, yellow, or green through energy density. Outcome measures included HTGC and DEXA, measured at baseline and 16 weeks. Dietary content was measured by tracking weekly red food counts via daily logs.

Our results suggest that decreasing consumption of high-energy-density foods in diet can positively impact whole body adiposity and liver fat, both important markers of metabolic risk. Changes were noted in both treatment groups, but were more prominent in the control group than the antipsychotic-treated group. Further investigation is needed to determine the effectiveness of this intervention in decreasing metabolic risk in antipsychotic-treated youth.

WHAT CAN SYNTHETIC BIOLOGY REVEAL ABOUT THE EVOLUTION OF ORGANISMALITY?

Libby Marguerite Ward
Mentor: Joan Strassmann

The transition from unicellular to multicellular organisms is a major transition in evolution. It has been hypothesized that the evolution of multicellularity was dependent on high relatedness between formerly independent entities. We used the social amoeba Dictyostelium discoideum as a pseudo-organism, a collection of microorganisms that can model certain growth stages and life cycles of multicellular organisms, to test how relatedness affects the spread of cheaters. This is important because a cheater would prevent the evolution of multicellularity. Two conditions that can increase relatedness are structured growth and structured dispersal. D. discoideum is a model organism for understanding the origin of multicellularity because it transitions between a unicellular, amoeba stage and a multicellular, fruiting body stage during its life cycle. We mixed a small proportion of cheaters that could not form a fruiting body on their own with our wild-type clone for our initial transfer so that the experiment would not be dependent on the spontaneous evolution of cheaters. There were four treatments varying growth and dispersal structure, and thereby varying relatedness among cells. We hypothesized that increasing relatedness would decrease the spread of cheaters. For the highest relatedness treatment, after five rounds of pseudo-organism growth, the cheater was completely eliminated from all but two of the five lines. The cheater was present in one of the five lines of an intermediate relatedness treatment. For the other intermediate relatedness treatment and the lowest relatedness treatment, there were no
cheaters in any of the lines. These puzzling results may be explained by other costs to the cheater phenotype of this particular clone, so future experiments should use different, non-fruiting clones. We believe using microbial evolution to mimic life cycle features of organisms at the beginning of multicellularity can be a useful tool for understanding this and other major transitions in evolution.

GRID SEARCH OPTIMIZATION
Daniel Wasserman
Mentor: Zachary Feinstein

This project consists of developing an algorithm that performs a grid search with minimal computation and short run-time. The goal of a grid search is to approximate an unknown function that defines a set. The algorithm can test whether an individual point is inside or outside of the set. Using this information, the algorithm iterates through the grid points and determines which points are in the set. Professor Zachary Feinstein made MATLAB code that performs a grid search, although the program has a long run-time, especially when performed on grids in more than two dimensions. This drawback poses a need for an algorithm that selects points in a more intelligent way. Selecting fewer points can decrease run-time and improve efficiency. The improved algorithm utilizes MATLAB’s parallel processing capabilities. The grid search starts on a sparse grid, then identifies regions close to the set boundary. The selected regions are then treated as separate grids. The grid search is performed on new grid points located inside each new grid. This process increases the number of total grid points, which allows for a closer approximation of the set’s boundary. The structure of the improved algorithm allows the computer to take advantage of its multiple cores, in which regions are analyzed simultaneously. Run-time is shorter as a result. The process of dividing the grid into regions is repeated, recursively, until the desired accuracy is obtained. The algorithm then returns the boundary of the set, which approximates the unknown function.

SOIL LEGACY EFFECTS OF INVASIVE GARLIC MUSTARD (ALLIARIA PETIOLATA) ON NATIVE COMMUNITY COMPOSITION
Caitlin Watanasiri
Mentors: Tiffany Knight

Invasive species introductions are considered one of the largest threats to global biodiversity. Preventing and mitigating their effects requires an understanding of the mechanisms that allow these species to dominate and persist in native communities. Recent evidence indicates invasive species can produce biological, chemical, or physical changes to native ecosystems which contribute to their success and persist after they have been removed: “legacies.” Previous research has looked at how these legacies may affect individual native species. Here, we investigate soil legacy effects through microbe-driven feedbacks at the community level using the invasive plant garlic mustard (Alliaria petiolata). Garlic mustard, a native to Europe, was previously thought to outcompete native forbs in the United States due to its rapid growth and allelopathy. Additionally, garlic mustard may have strong indirect effects on native plants communities since its antifungal properties inhibit the formation of arbuscular mycorrhizal fungi (AMF), on which most forest understory species rely. To test the importance of garlic mustard’s indirect effects, native plant communities were grown in one of four soil treatments: soil conditioned by garlic mustard, soil conditioned by natives, sterilized soil conditioned by garlic mustard, and sterilized soil conditioned by natives. Early growth was significantly affected by soil invasion history, with natives showing less productivity in soil invaded by garlic mustard. Individual native species performance, as measured through biomass, found that only the native species Geum canadense showed a specific preference for live soil conditioned by natives. Total above ground biomass, community diversity, and AMF colonization were not significantly affected by soil conditioning. Soil microbia associated with garlic mustard had a marginally significant effect on community structure. The results suggest that garlic mustard alters the soil microbial community in a way that is detrimental to specific native species and may affect overall native community structure.

Andrew Wellen
See Tiffany La

John Wieser
See Steven Grigsby
TH E IM PA CT O F C LO TH IN G C H O IC E O N PERC EPTIO N S O F FEM ALE IN TELLIG EN C E

Maxine K. Wright
M entor: Michael J Strube

This study looked at how visual stereotypes can impact the perception of intelligence in women. Most of the research on gender differences in perceptions of intelligence focuses on self-estimated intelligence. However, there is very little research on how an individual’s biases (i.e., their belief in the validity of certain stereotypes) can influence their perceptions of another person’s intelligence, not just their own. The present study attempted to address that research deficit, and looked at how style of dress can change one individual’s perception of another’s intelligence. In addition to filling out some questionnaires to assess their own personality traits, participants were asked to rate a series of images based on their first impressions. They rated the person in each image on academic talent, interest in current events, and other personality traits. Within that set of images there were two women, one blonde and one brunette, who appeared twice. In one image, they were dressed conservatively and in the other, they were dressed provocatively. My hypothesis predicted that people would see the woman as less intelligent when she was dressed in more revealing clothing. The results strongly supported the hypothesis, and showed that, in general, people do in fact perceive a woman’s intelligence differently based on what she’s wearing. The data also revealed
some interesting differences in perceptions of personality traits, such as neuroticism and sociability, based on style of dress. The findings are not unexpected for most people, but they are important because they act as empirical evidence that visual stereotypes impact our daily interactions.

**EVALUATION OF OXFORD NANOPORE SEQUENCING TECHNOLOGY**

Fangzhou Xiao  
Mentor: Rob Mitra

Oxford Nanopore sequencing technology is a new single-molecule DNA sequencing technology that is commercialized and currently in trial phase. It has the advantage of long read-length and portability. Despite its advantages over classical next-generation sequencing methods, the current reads are error-prone. In this ongoing project, I use computational tools to analyze the types of errors that Oxford Nanopore system makes, devises base-calling algorithms that improve upon read quality, and potentially apply Oxford Nanopore system to novel applications.

Ruicong Yan  
See Ryan Geczi

**COCKTAIL PARTY HEARING AID USING A MICROPHONE ARRAY**

Luting Yang  
Mentor: Ed Richter

Hearing in the presence of background noise is challenging enough for people with normal hearing. The problem is much worse for the hearing impaired. It is also a situation where traditional hearing aids don't perform well. In this project, the researchers used a 64-element microphone array. We placed the array in the center of a table while several people sitting at the table carried on a normal conversation to produce the Cocktail Party Effect. Using data collected from the microphone array, the researchers developed algorithms to perform beamforming by rotating the beam pattern in one degree resolution to find the signal. In this way the array can remove the background noise and amplify the current speaker’s voice signal. The current speaker's voice signal can be identified based on the direction of the maximum signal strength. The second part of this project is to track the current speaker from the pose of the listener identified with a camera. It is common sense that people always stare at the people to whom they are speaking. The researcher applies the new algorithm to the camera-based device to help the microphone array amplify the signal. This filtered signal will then be transmitted to the smartphone of a hearing impaired person wearing one or two headphones.

**COUNTER-REGULATION IN PURCHASE SITUATIONS AND ITS EFFECT ON POST-BEHAVIOR HAPPINESS**

Xueer (Sherry) Yu  
Mentor: Michael Strube

Counter-regulation – a small slip in self-control that triggers a larger lapse – is a concept that has been well-researched in the dieting literature, but for which very limited research exists outside this realm. There have been relevant previous studies in consumer behavior regarding this concept, but those studies did not touch on the key component of the initial self-restriction of the original counter-regulation effect. This research examines whether and how personality differences and the type of purchase (material or experiential) influence consumers’ happiness after engaging in counter-regulatory behavior. Personality and state of happiness are assessed through self-reported questionnaires whereas the behavior is simulated through a five-minute writing task. Although the results are largely non-significant in this study, there are potential limitations to the experiment situations and methods and the concept could use further study after modification to the procedure. The results nevertheless provide insight for future studies on and understandings of choice and happiness.

Alexander Zaiken  
See Ryan Geczi
AS BLUE AS THE C: 
EXAMINING THE FEATURE OVERLAP MODEL OF SEMANTIC PRIMING WITH 
GRAPHEME TO COLOR SYNESTHESIA
Miriam Zawadzki
Mentor: David Balota

The present study investigated priming effects with color-related target words when non-word primes elicit a color response in a population of grapheme-to-color synesthetes, or no color response in a yoked group of control participants. Grapheme-to-color synesthetes experience color upon viewing monochromatic letters and digits. If priming effects are present for similarly colored words it would provide evidence for the feature overlap model of semantic priming, since the synesthetic experience of color does not provide the physical color associated with the noun. Participants completed animacy judgments on common nouns that are strongly semantically related to a particular color (i.e. Tomato is related to red). These nouns were primed with non-words (for 150 ms duration) that included individually determined letters that produced strong color synesthesia. Although our results are inconclusive due to a small number of participants (11 synesthetes), our findings thus far appear to suggest that there are no conclusive priming effects due to congruency/incongruency of color.

IS THE GRASS REALLY GREENER ON THE OTHER SIDE? 
AN EXPLORATION OF THE EFFECTS OF ASTROTURFING
Michael Zhou
Mentor: Eileen G’Sell

Astroturfing is commonly defined as the practice of using fraudulent or synthetic grassroots movements in order to influence public opinion. By mimicking genuine grassroots movements, those who Astroturf are able to use fronts that generate credibility and affect prevailing beliefs. There has been an extremely worrying rise in usage of this tactic, mostly by corporations, in order to exert control over marketing and political issues. Astroturfing can also be extremely difficult to spot and if done right can engender organic growth of a corporate standpoint rather than a genuine grassroots one. Allowing business interests to clash with societal wants and needs poses serious risks in and represents an ethical concern for those being manipulated.

For this research, I compiled known cases of astroturfing and elucidated the general concerns that are associated with the practice. Specific examples include corporate sponsorship of the Tea Party as well as the fight against global warming awareness. This research also gathered possible methods for making Astroturfing less effective, such as the introduction of harsher penalties for companies caught engaging in it as well as a call for transparency in funding. Given the extreme ease with which it is done and the growing popularity of it, if no action is taken against Astroturfing in the near future, it is very easy to see a society where the population is manipulated by a corporate agenda without being aware of it.

Michelle Zhu
See Jonathan Finch

Jon Zielke
See Gabrielle Bleich

Tina Zudock
See Micah Rickles-Young
STRUCTURE-FUNCTIONAL ANALYSIS OF PHOSPHOETHANOLAMINE METHYLTRANSFERASE 1 FROM THE PLANT PARASITIC NEMATODE BURSEHELENCHUS XYLOPHILUS

Michelle Chung, Antea DeMarsilis, Cynthia Holland, Rohit Jaswaney, Sharon Jiang, Jakob Kroboth, Kevin Kulshrestha, Raymundo Marcelo, Vidhya Meyyappa, Grant Nelson, Janki Patel, Alex Petronio, Samantha Powers, Peter Qin, Mythili Ramachandran, Divya Rayapati, John Rincon, Andreia Rocha, Joan Gabriel Rodinho Nunes Ferreira, Micah Steinbrecher, Kaisen Yao, Eric Zhang, and Angela Zou
(These authors contributed equally to the work as students in Bio 4522)

Mentors: Wilhelm Cruz and Joseph Jez
PRESENTERS’ ACKNOWLEDGEMENTS

Katherine Alexander, Paul Felder, John Garza and William Lyons — Sarah C. R. Elgin, Kathy Hafer, Chris Shaffer, Rachik Patel, Rohan Khazanchi, Nathan Kopp, Calvin Stephens

Gabriella Alvarez — Deanna Barch, Katherine Luking, David Pagliaccio, Jim Sketh, Jennifer Kohl and Diana Mitchell

Courtney Amegashie — Amanda Lewis, Nicole Gilbert, Warren Lewis

Gabriel Arguelles — Eileen G’Sell

Garrett Walter Arosemana Ott — Wolff Distinguished Professor Marcus E. Raichle, Professor Martin H. Israel, Ph.D. student Tyler Blazey and MISTP student Anish Mitra for outstanding mentorship; Jim Sketh and Jennifer Kohl for their generous support in the uSTAR program

Odion Asikkhia — Dr. Strassmann, Tamara Haselkorn, Fred Inglis, and Kai Jones

Amee Azad — Dr. John Baugh, Dr. E. A. Quinn, Dr. Will Ross, Deepak Azad (father), Vyma Pathakjee (mother), Tej Azad (brother), and friends

Diane-Jo Bart-Plange — John Baugh, Ph.D., Kimberly Norwood, Ph.D.

Margaret Bavlsik — Dr. Bal, IAS faculty

Deko Becker-Ricketts — Ben Rosencranz, Dillon Williams, Arne Nehorai, Dedric Carter

Vincent Biase — Maire Murphy and Heidi Kolk

Gabrielle Bleich, Benjamin Eisenberg, Phoebe Moh and Jon Ziekle — Dr. Kathy Hafer, Dr. Chris Shaffer, and Dr. Sarah Elgin

Sophia Borgeois — Anna Hood, Desiree White

Alicia Canas — I would like to thank Kai Jones for carrying out this project with me and my mentor Debbie A. Brock for her support and guidance. I would also like to thank all members of the Strassmann/Queller laboratory on Social Evolution and Multicellularity.

Janice Cantieri — Bret Gustafson, Dean Joy Kiefert, Kem Sawyer, Pelenien Alofa, Amon and Tekinina Timan

Gina Chang — Dr. Beau Ances, Laurie Baker, Matthew Brier, Aaron Tanenbaum, Elizabeth Westerhaus, and the rest of the Ances Lab

Elizabeth Chen — Special thanks to Wilson Leung for his assistance and guidance; to Thomas Quisenberry; Kevin Ko, and the GEP students and faculty for their genome contributions, and to the Elgin lab for their support throughout this entire analysis and thesis.

Meytal Chernoff — E. A. Quinn, Geoff Childs

Danielle Cicka — Dr. Nicole White

Emily Condiff — Broc McCune, Angen Foundation, Friends and family

Kaitlyn Crawley — Zachary Feinstein

Eric Dai — My mentor, Dr. Chen, for tireless patience towards science and undergrads, and the Branco Weiss Fellowship for funding

Marie Draper — Dr. Mairin Hynes and Dr. Patrick Gibbons with the Department of Physics and Dr. Wendy Anderson and Dr. Rebecca Wanzo with the Center for the Humanities

Juliet Eisenstein — Ashley Macrander, Linda Lindsey, Maire Murphy and Heidi Kolk

Tyler Ellison — Renato Feres, Advanced Research Training for Undergraduates (ARTU) administration

Mackenzie Findlay — Carolyn Sargent, Barbara Baumgartner, Mary Ann Dzuback, Jami Ake, Judi McLean Parks, Armand Randrianasolo

Jake Foote — Dr. Jeffrey Miner and Dr. Indira Mysorekar

Christian Freeman — E. A. Quinn, all involved in the Human Biomarkers Lab, and the Anthropology Department

Samuel Funderburk — Dr. Martin J Schmidt, Jordan G McCall

Aakash Gandhi — Audrey Odom, Ann Guggisberg

Jackson Gartman — Dr. Vladimir Birman, Nicholas Ahlmeeyer, and Krishna Sharma Gautam

Rachel Grant — Shining Chen, Diana Brightman and the rest of the Chen lab. Histology Core, U-STAR Program

Rachel Grant, Jordan Grainger and Greg Harrison — Professor Douglas Chalker, and TAs Anna and Andrew

Zoe Grezce — Thank you to Eileen G’Sell for pushing the development of my ideas and encouraging me to get out into the city, as well as to the friends and family members who supported my work

Steven Grigsby — My mother, Petra Levin, Levin lab, Pappu lab

Kate Harline — Tyson Research Center, Maranda Walton, Dr. Johnathan Myers, Dr. Claudia Stein, Dr. Scott Mangan

Daniel Hong — Jordan McCall, Michael Bruchas

Michael Hoosier — In addition to my diligent advisor Dr. Ian MacMullen, I would like to thank Dr. Clarissa Hayward and Dr. Frank Lovett. Their classes and opportunities challenged and transformed my thinking. It is to them that my intellectual debt is greatest.

Arian Jadbabaie — Kater Murch, my family, everyone in the Murch Lab: Neda Forouzani, Dian Tan, Mahdi Naghillo, Satcher Hsieh, Chris Munley, Naveen Jain — Shaym Kavuri, John Monsey, Wei Shen, Adam Searleman, Runjun Kumar, Kobay Sarpang

Jessica Joseph — I’d like to thank Dr. Amit Mogha, Dr. Kelly Monk, and the rest of the Monk lab for their amazing help.

Samantha Karlow — Eva Blumenfeld, Daniela Diego, Samantha Gaitis, David Levitt, Deborah Li, Kiri Maassen, Marina Mai, Ruth Blair Moyer, Cassandra Mitchell, and Lance Peterzell

Brian Katz — Ariana Vanderveldt

Daniel Kennedy — Mellon Mays Undergraduate Fellowship, Dean Mary Laurita, Dr. Kedron Thomas, Dr. Peter Benson, Dr. Shanti Parikh, Dr. Jeffrey McCune

Christina Kreisch — CK thanks NASA’s JPL and Wash U for the hospitality and support. Many thanks to Olivier Doret, Francis-Yan Gyr-Kacine, Francesc Ferrer, and Mike Seiffert for the support and answering her many questions.

Amrutha Kumaran — Dr. Carolyn Sargent, Dr. Priscilla Song, Dr. Geoff Childs, Dr. Talia Dan-Cohen, Dr. Lewis Wall, Dr. T. L. N. Praveen, Dr. Surekha Pandit, Sharada Pandit

Yang Lee — Amy Langdon, Terence Crofts, Gautam Dantus

Dan Li — Monica Sala-Rabanal, Sunjoo Lee, Phuong Le, Risha Shah, Darian Wiggall, Simonne Francis and Valentina Ghisays.

Landon Lichtenstein — Thank you Gregory Ott, Sharon Madneke, and my family for your support

Jennifer Liu — Washington University in St. Louis Department of Orthopaedic Surgery

Margaret Liu — Musculoskeletal Soft Tissue Lab

Patrick Lopatto — I would like to thank Professor Rochberg for his unwavering support and guidance.

Alexander Lu — The Cruchaga Lab, Dr. Cruchaga, Kuan-fun Huang, Peter Jin, and Jenny Lord

Wei Luo — Ed Richter, Arne Nehorai

Hunter Malisky, Steven Grigsby, Vita Jaspian and Jon Wiesen — Thanks to Professor Doug Chalker, Andrew, Anna, and everyone in Biology 3492

Joseph Marmerstein — Katherine Holzem

Christy Marx — Jami Ake, Carolyn Sargent, Amber Musser, and Barbara Baumgartner

Stephanie Montenegro — Susanne DiSalvo, Tamara Haselkorn, Usman Bashir, Dave Queller

Nevuda Murugesan — My PI, Dr. Steven Brody, and my bench mentor, Sean Gunsten

Hansika Narayanan — Thomas J. Baranski, Jill Thompson

Austin Niu — Dr. Lee Rattner, Dr. George Kyei, Rashmi Ramani, The Rattner Lab

Caroline Nore, Monica Perumattam, Denton Hui and Brandon Lau — We would like to thank Drs. Sarah Elgin, Kathy Hafer, and Christopher Shaffer, along with our course TAs.

Courtney Oben — I would like to thank Dr. Maire Murphy, for being a constant source of support as I progressed through the many phases of my project.

Aine O’Connor — Merle Kling Fellowship, Professors Sunita Parikh and Dawn Brancati, and the Senior Honors Thesis seminar group

Cassie Parks — Dr. Gregory Wu, Dr. Angela Archambault, Chelsea Parker, Mariiah Lawler, Dr. Erica Koval, and Dr. Timothy Miller.

Ruchik Patel — Mike Nonet, Scott Dour

Amy Patterson — Tiffany Knight, Sam Levin, Cassandra Galluppi, Erynn Maynard

Gina Phillips — Dr. Peter Benson, Dr. Sarah Gehlert, Ms. Lailea Nod, Dr. Geoff Childs, Dr. Heidi Miller, St. Louis Breast Navigators, Community Partnership Center, Department of Anthropology

William Pierson — Hani Zaher, Benjamin Hudson, Carrie Simms

Neha Prasad — Dr. Wencewicz, Jason Schaffer, Margaret Reck

Harrison Pravder — I would like to thank Kathy Miller for giving me the opportunity to do research in her lab. I would also like to thank Dorota Grabowska for her invaluable guidance and help.

Thomas Quisenberry — The GEP, Sarah Elgin, Wilson Leung, Chris Shaffer, and Elizabeth Chen

Matthew Ranftle — Mark McDaniel, Jeri Little
PRESENTERS’ ACKNOWLEDGEMENTS

Ryan Rees — The Challen Lab, in particular Dr. Challen and Hamza Celik, Dr. Shondra Miller of the Genome Editing Core, SURF; Professor Sobotka

Micah Rickles-Young, Shaarada Srivatsa and Thomas Van Horn — Nathan Kopp, Ruchik Patel, Rohan Khazanchi

Reuben Riggs — All those dedicated to the Ferguson movement

Samantha Rogers — Christine Johnson, Joseph Loewenstein, Derek Hirst

Alex Rosenthal — Carolyn Sargent, Peter Benson, John Bowen, and Bradley Stoner

Erica Ryu — I would like to thank the Queller-Strassmann lab for this research opportunity, especially Fred, Joan, and Tammy for their advising. I would also like to thank my parents for helping me find great opportunities and for their valuable guidance.

Abhishek Saxena — Dr. Deanna M. Barch, Dr. Katherine R. Luking, Dr. David Pagliaccio, Carol Cox and the entire CCP Family

Carley Schleien — I would like to thank Crickette Sanz, David Morgan, Stephanie Musgrave, and the members of the Digital Laboratory for Primate Behavioral Research.

Maria Schletzbaum — Eva Istvan, Daniel Goldberg

Sonya Schoenberger — Elizabeth Borgwardt, Sonia Lee, Wendy Love Anderson, Merle Kling 2015 Senior Cohort

Adam Seroka and Sonya Anderson — Douglas Chalker and students

Kristoffer Sladky — Dr. Peter Benson, Dr. Bradley Stoner, Dean Carolyn Herman as well as Kirsten Jacobsen and the Department of Anthropology

Amelia Snyder — Scott Mangan, Alexandra Harmon-Threatt, Mike Dyer

Arvind Srinivasan — Dr. Daniel Hanson

Amanda Stadermann — Brad Jolliff, Michael Zanetti

Leslie Sterling, Madeleine Mullon, Rahul Ramaswamy and Peeti Sithiyopasakul — We would like to thank our professors, Graham Hatfull, Washington University in St. Louis, and the Danforth Plant Science Center.

Kelsey Stiles — Thank you to Dr. Joshua Jackson, the members of the Personality Measurement and Development Lab, and Dr. Mitchell Sommers for their help with this project.

Andrea Stoica — Laboratory of Emerging and Applied Nanomaterials

Joljit Tamanaha — Randall Calvert and Dawn Brancati

Yuni Teh — Dr. Nehorai, Ed Richter, Singapore Institute for Neurotechnology, Dr. Yen Shih-Cheng, Thanawin Trakoolwilaiwan, Alexander Lim, Claire Poulard

Joshua Trosh — Professor Timothy Moore, Professor William Babalis

Darby Turner, Rachel Mickelson, Tiffany La and Andrew Wellen — Dr. Sarah Elgin, Dr. Chris Shaffer, Dr. Kathy Hafer, Nathan Kopp, Ruchik Patel, Rohan Khazanchi, the Graham Hatfull lab

Bianca Vannucci — Everybody in the BRAIN lab!

Courtney Vishy — I would like to thank Victoria Thomas, my Writing 1 professor, for guiding me through this project.

Emily Vivio — Matthew Ciorba

Emily Walco — Aileen Sweeney, Cassandra Ekadahl, Frank Willems, Marley Katinta, Kennedy Kaheha

John Wang — Dr. Ginger Nicol, Vincent Huang, Michael Yingling

Caitlin Watanasiri — My mentors Kerri Crawford and Tiffany Knight, Mike Dyer and the greenhouse staff.

Chase Westra — Dr. James M. Fleckenstein, Allaullah (Tutul) Sheikh, Timothy Vickers, Qingwei Luo, Pardeep Kumar, Washington University Department of Biology

Olivia Williams — The Strassmann Queller Lab

Madeline Wilson — Lana Kerker, Crickette Sanz

Maxine Wright — Michael Strube and the research assistants at the Social Behavior Lab

Xueer Yu — Professor Mike Strube and all the Research Assistants of Social Behavior Lab

Michelle Zhu, Alexander Hinch, Jonathan Finch and Batu Otkeren — Bill Bottom

Michael Zhou — I wish to thank my family, Ray Lo, Stephen Mell, Fayzan Chaudhry, Spencer Williams, and Edward Lim as well as my other friends for always being there for me. I would also like to thank Eileen G’Sell for her guidance in crafting the paper.