Tufts 18th Annual Undergraduate Research and Scholarship Symposium

May 3, 2016
Welcome to the 18th Annual
Tufts Undergraduate Research and Scholarship Symposium!

The Undergraduate Research and Scholarship Symposium, Tufts’ flagship annual undergraduate academic conference, is dedicated to celebrating the exemplary research of our students. The students have worked on fascinating projects under the efficient guidance of our professors in a broad range of disciplines.

Panel discussions consisting of oral presentations will be held in the Campus Center from 12:30 pm to 2:30 pm, and again from 4:00 pm to 6:00 pm. The poster session will be held at the Crane Room from 2:30 pm to 4:00 pm. The Symposium will close with a plenary address by Dr. Anthony Monaco, President of Tufts University, at 6:00 pm, followed by a dinner reception, at Sophia Gordon Hall.

For the past eighteen years, this Symposium has been an unparalleled platform for active academic dialogue among scholars. Intellectually stimulating analysis and meticulous research of our presenters have inspired a generation of Tufts students to follow their footsteps. We congratulate the presenters and their mentors on the tireless effort that has produced such valuable academic work. This booklet contains brief abstracts of the research papers being presented at this year’s Symposium. We cordially invite you to all panels and presentations, and wish you a wonderful day ahead!

With warm regards,

2016 Undergraduate Research and Scholarship Symposium Committee

Alexandra Brumberg, 2016, ACS-certified Chemistry and Mathematics
Aniket De, 2016, History and Anthropology
Phuong N. Dinh, 2017, Cognitive and Brain Sciences and Philosophy
Shen Tang, 2016, International Relations and Economics

Faculty Advisor: Dr. Harry Bernheim, Department of Biology
Staff Advisor: Dr. Anne Moore, Program Specialist, Scholar Development
Schedule of Events

11:30 – 12:30 pm  Lunch and Registration  
*Sophia Gordon Multipurpose Room*

12:30 – 2:30 pm  Oral Presentations, Session #1  
*Mayer Campus Center*

2:30 – 4:00 pm  Poster Presentations  
*Crane Room*

4:00 – 6:00 pm  Oral Presentations, Session #2  
*Mayer Campus Center*

6:00 pm  Plenary Talk – President Anthony Monaco  
Closing Reception and Dinner  
*Sophia Gordon Multipurpose Room*
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<td>Katherine Campbell</td>
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Abstracts

Particle inhalation rate as a metric for ambient air pollution exposure
Harsha Amaravadi, 2016, Biology & Community Health
Laura Corlin/Dr. David Gute, Civil and Environmental Engineering/Community Health

Association of Ultrafine Particulate Matter with Blood Pressure in Near-Highway Communities
Shannon Ball, 2016, International Relations; Community Health
Laura Corlin; Doug Brugge, School of Engineering; School of Medicine

Background: While exposure to traffic-related air pollutants such as fine particulate matter has been linked to cardiovascular health effects, few studies have examined the effects of ultrafine particulate matter (<100 nm, UFP). Our aim was to examine the relationship between UFP exposure (measured as particle number concentration or PNC) and blood pressure (BP).

Methods: Data from 419 participants in the cross-sectional Community Assessment of Freeway Exposure and Health (CAFEH) study were analyzed (mean age=61 years; 59% female). Participants were recruited from three near-highway communities around Boston. Of the study participants, 45% were White, 36% were East Asian (100% foreign-born), and 20% of participants were classified as other. Hourly ambient PNC was predicted using spatial-temporal regression models. Ambient annual average PNC was adjusted for participant reported time-activity in five micro-environments (inside home, outside home, school/work, commuting, and other) to obtain personal time activity adjusted PNC (TAA-PNC). Bivariate and multivariate associations between TAA-PNC and systolic blood pressure (SBP), diastolic blood pressure (DBP), pulse pressure (PP), and hypertension (SBP>140 mmHg, DBP>90 mmHg, self-reported hypertension, or taking hypertension medications) were examined. Multivariate models controlled for age, sex, body mass index, race, education, smoker status, and diabetes.

Results: TAA-PNC values ranged from 8,807 to 34,745 particles/cm^3. TAA-PNC was not significantly associated with SBP (β=1.08, 95%CI=-3.80, 5.97), DBP (β=-0.24, 95%CI=-3.01, 2.51), PP (β=1.33, 95%CI=-2.50, 5.16), or hypertension (OR=1.50, 95%CI=0.74, 3.04) in multivariate analyses. Non-significant trends were observed in analyses stratified by race. In a multivariate regression of TAA-PNC on SBP, White participants exhibited a strong but not significant positive association (β=7.16, 95%CI = -1.55, 15.86) while East Asian participants exhibited a negative association (β=-1.42, 95%CI=-8.01, 5.17). Similar results were found for DBP, PP, and hypertension.

Conclusions: We found no evidence that TAA PNC exposure was associated with BP.
Anxiety, Academics, and Alcohol: A Quantitative Study of Universities by Facebook Confession Boards
Soubhik Barari, 2016, Mathematics; Computer Science
Remco Chang, Department of Computer Science

Confessions pages have grown popular on social media sites such as Facebook and Twitter, particularly within college communities. Such pages allow users to anonymously submit confessions related to collegiate experience that are subsequently broadcast on a public forum. Because of the anonymous nature of disclosure, confessions pages are novel data sources from which to discover trends and issues in a collegiate community. Facebook confessions boards also have the potential to monitor depression, physical illnesses, and other student issues from a discrete portal and offer relevant, informative resources to the larger university communities they pertain to. In this presentation, I discuss findings on the Tufts community in addition to aggregate trends across American universities. Using a variety of quantitative tools, natural language processing techniques, as well as data from the U.S. National Center on Education Statistics, we do a comparative analysis of confessions content by different school categories as well as estimate probabilistic correlations between university features and student discourse. For example, we find that campuses with a high proportion of white students (>1 std. dev than the mean across universities with confessions pages) have significantly different confessional topics than campuses with more student diversity in topics such as academics, mental health, and partying. We hope that findings from this initial study motivate third parties to develop automated social network tools for promoting student health and well-being as well as Facebook, Twitter, and other networks themselves to design more community-oriented features and analytics on their platforms.

Study of the Host Immune Response to Influenza Vaccination: An Application of SiMoA for the Multiplex Detection of Cytokines
Bruce Bausk, 2016, Biochemistry; Spanish
Trinh Dinh, Walt Laboratory Group, Chemistry Department, Tufts University

Influenza vaccination stimulates the host immune response and induces the production of protective antibodies in the host. Since cytokines are known for their involvement in inflammatory and immune responses, the host immune response to an influenza vaccine was studied using cytokines as potential biomarkers. Blood samples were collected at 10 time points over the course of 13 weeks; these time points were chosen to be before, directly after, and weeks after vaccination in an attempt to monitor the baseline cytokine levels, short-term innate immune response, and longer-term adaptive immune response. Serum samples were analyzed for cytokine levels through the use of Single-Molecule Arrays (SiMoA), allowing for the multiplexed, sub-femtomolar detection of cytokines. The Limit of Detection (LOD) was found to be significantly lower than the LOD for conventional Enzyme-Linked Immunosorbent Assay (ELISA), allowing for the detection of cytokines that would be otherwise undetectable using commercially available techniques. Serum samples showed a detectable short-term innate immune response in some cytokine biomarkers, but no long-term adaptive response could be determined via the cytokine biomarkers studied. This study shows an application of SiMoA, and indicates that this platform could be used for the study of immunological responses in other disease models.
Medication Management in Men and Women with Parkinson’s Disease: Challenges and Strategies
Haley Bliss, 2016, Biology; Community Health
Linda Tickle-Degnen, PhD, OTR/L, FAOTA, Tufts University Health Quality of Life Lab, Department of Occupational Therapy

Background: Management of Parkinson’s disease (PD), a chronic movement disorder, involves a complex medication regimen, requiring increasing daily doses as the disease progresses. The majority of PD patients fail to adhere completely to their medication regimens, and this suboptimal adherence can be detrimental. Underuse of antiparkinsonian medications can cause bradykinesia and rigidity, and overuse can cause dyskinesia, confusion, visual hallucinations, and obsessive behavior. Purpose: This study aimed to see what challenges lead to nonadherence, and what strategies people use to effectively manage their medications and organize their medication schedules. Methods: Findings are reported from baseline qualitative interviews from a longitudinal study on social self-management in PD being conducted in Dr. Tickle-Degnen’s Health Quality of Life Lab through the Tufts Department of Occupational Therapy. Interviews from twenty people with PD (10 men, 10 women) were coded using NVivo Qualitative Analysis under the construct of the Person-Environment-Occupation (PEO) model used in occupational therapy practice. Results: Instances of ineffective medication management included forgetting pills, adding extra pills for certain activities, skipping pills, and not taking pills on a consistent schedule. Strategies for effective medication management included person-centered strategies (P) such as using pill boxes and alarms, organizing medications around mealtimes, and using emerging symptoms as a reminder; environment-centered strategies (E) such as strategic placement of pills and water, and having support from a spouse; and occupation-centered strategies (O) such as talking to a healthcare provider to change a medication regimen. Conclusion: Reasons for nonadherence and strategies for effective management were highly varied among participants. Therefore, interventions to improve medication management should be individually targeted to personal characteristics (P), social and physical environments (E), and daily activities (O).

Pressure Points: Acupuncture in the American Medical System
Alexandra L. Boden, 2016, Biology; Anthropology
Sarah Pinto, Anthropology

Biomedicine, while based in science, is not independent of human culture or human experience, and is subject to both external and internal cultural forces, perpetually reconstructing a new American medicine. In this ethnographic study, I examine how the domains of biomedicine and traditional Chinese medicine (TCM) intersect in the context of one American doctor, Dr. M, who practices both acupuncture and a number of biomedical specialties, such as neurology and sleep medicine.

This research highlights a cultural shift in American medicine from idolizing the scientific nature of biomedicine to a more disillusioned view that resents the reductionism and oppression associated with politics and the biomedical industry. As a result, there is an increasing demand for biomedicine to adopt a more holistic approach, addressing a scope of health care that goes beyond the biological. Practices, such as acupuncture, are becoming less of a last resort or and have moved into a liminal space between dismissal and legitimacy as "complementary" treatments, slowly progressing towards validation.

Dr. M’s practice is at the center of this liminal space, navigating the assumptions held by patients and colleagues about acupuncture, while also actively legitimizing it by transplanting it into the biomedical system,
subjecting it to the cultural forces of biomedicine just as his biomedical practice is touched by the TCM system. Ultimately, this is an example of how these two independent cultural systems of medicine can co-exist in one space, demonstrating how tensions between science and cultural authenticity work to bring legitimacy to this emergent, more holistic model of American medicine.

**Biotic Interactions Impact Rapid Evolution of Penicillium to the Cheese Environment**

Ina Bodinaku, 2016, Biology; Women’s Gender and Sexuality Studies (WGSS)

Dr. Benjamin Wolfe, Biology

While numerous studies have examined the rapid evolution of microbes, few have considered how biotic interactions with neighboring species may impact the rate and mode of microbial evolution. We examined phenotypic evolution of the fungus Penicillium to the cheese environment in two different treatments: alone with no neighbors (-community), and with neighboring microbes (+community). Diversification was measured by the relative abundance of pigment mutants. The effects of biotic interactions on the rate and extent of domestication was determined to be strain-dependent. The rapid evolution of Penicillium to the cheese environment was characterized by changes in a variety of fungal characteristics in addition to pigmentation, including spore production, mycelial growth rate (MGR) and mycotoxicity. The evolved wild type and evolved mutant strains differed across all of the traits measured, suggesting different evolutionary trajectories in the adaptation of Penicillium to the cheese environment. Mutant strains were categorized into three distinct classes based on variations in these fungal characteristics. For the evolved mutant strains, changes in the expression of traits were not caused by mutations at the genomic level suggesting alterations to regulatory pathways controlling the expression of these traits. Understanding the evolutionary mechanisms that underlie the adaptation of contaminant species like Penicillium to the cheese environment has very important implications for the cheese-making industry, in addition to providing the opportunity to address basic biological questions.

**The Normative Implications of Moral Psychology: Bridging the gap between is and ought**

Dillon S. Bowen, 2016, Philosophy; Cognitive and Brain Sciences

Andreas Kappes, Experimental Psychology

It has become the orthodox view, both among philosophers and academics more generally, that one cannot obtain an ought from an is. That is, we cannot infer how the world ought to be based on knowledge about the way the world is. In a similar vein, it has often been said of moral psychology that one cannot infer how we ought to make moral judgments based on knowledge about the way it is that we make moral judgments. Philosophically ambitious moral psychologists, however, argue that while moral psychology does not afford us a complete picture of how we ought to make moral judgments, it nevertheless has something valuable to tell us about moral philosophy. But what and how does moral psychology teach us about moral philosophy? In this talk, I describe two ways in which moral psychology impinges on moral philosophy, which I call the revealed preferences function and the debunking function. Respectively, these functions serve to 1) reveal hidden prosocial preferences which we ourselves may be unaware of, and 2) explain away objects of merely ostensible moral importance. Finally, I sketch how the revealed preferences function and debunking function of moral psychology can help us construct an ethical theory. Specifically, I argue that our revealed preferences approximate a philosophical view I call big-picture utilitarianism, and that many of the deontological intuitions which run contrary to our revealed preferences can be explained away by evolutionary and cultural debunking.
Vascular contributions to cognition and clinical outcome in MCI
Emma C. Boyd, 2016, Biopsychology
David Salat, PhD, Martinos Center for Biomedical Imaging, Massachusetts General Hospital

Previous research has suggested there may be two independent sets of covarying degenerative brain changes contributing to the development of Alzheimer’s disease (AD): ‘age-and-vascular’ associated damage and classical ‘neurodegenerative’ changes. Certain vascular pathologies may be a mediating factor in the conversion from MCI to AD. Thus, we evaluated the hypothesis that white matter changes of presumed vascular origin are related to various cognitive deficits in MCI. The relationship between neuroimaging measures and neuropsychological assessments commonly used in AD research was examined in 169 individuals with MCI using data from the Alzheimer’s Disease Neuroimaging Initiative. Factor analysis on neuropsychological measures suggests three different outcomes of disease progression: general cognition, clinical outcome and executive function. General linear models of neuroimaging measures on neuropsychological factors suggested that both ‘vascular’ associated and ‘neurodegenerative’ neuroimaging measures contribute strongly to cognitive and clinical decline. Longitudinal models suggested that both sets of neuroimaging measures can be used to assess cognitive dysfunction and decline over several years. We interpret the factor analysis results as being suggestive that ‘classical’ features of AD development have been misinterpreted and are in fact tied to poor vascular health and subsequent vascular brain damage. Our results confirm the relevance of studying white matter changes in cognitive impairment as this pathology may suggest a secondary, concurrent pathway to AD development.

Thermodynamic Properties of Single-Crystal D2O Ice
Alexandra Brumberg, 2016, ACS-certified Chemistry; Mathematics
Mary Jane Shultz, Chemistry

Water is such an abundant resource on our planet that ancient philosophers deemed it one of the four major elements. Although it is not regarded as an element nowadays, its fundamental role on our planet has not been trivialized and many of its scientific complexities continue to puzzle researchers. Single-crystal ice is one of the most useful tools available to researchers studying water; the hydrogen bonds in ice are more rigid, locked within the ice lattice, and thus minimize the vibrational motions and transient hydrogen bonds that complicate water analysis. But, preparing single-crystal ice is easier said than done. In this work, the single-crystal growth mechanism for H2O ice has been adapted for the growth of D2O ice (ice in which the hydrogen in water is replaced with deuterium, an isotope of hydrogen with an extra neutron). The modifications that are required are more complex than simply adjusting for their difference in freezing point. A surface etching technique is also used to characterize the ice surface, through which differences in the interfacial energies of H2O and D2O can be visualized. Overall, the properties seen with D2O reveal a significantly different thermodynamic landscape for D2O rather than H2O. If these differences can be well understood, then other researchers growing single-crystal H2O ice will be able to more easily adapt their method to the growth of D2O ice, which will allow isotopic studies (such as in spectroscopy) to be utilized when studying water.
Continuous Renal Replacement Therapy in Pediatric Patients Receiving Extracorporeal Membrane Oxygenation at St. Louis Children’s Hospital
Katherine Campbell, 2018, Biology
Dr. Keefe Davis, Washington University School of Medicine/St. Louis Children’s Hospital

Extracorporeal Membrane Oxygenation (ECMO) is a temporary, extracorporeal therapy used to support perfusion and oxygenation in a critically ill patient. ECMO can be a life sustaining bridge to recovery for patients who fail to respond to conventional ventilation and/or circulatory therapies. Patients treated with ECMO, frequently develop multiorgan failure including acute kidney injury (AKI). The best management and the outcomes of AKI in this critically ill population have not been well studied; therefore, management of these patients varies from center to center. For instance, some centers simultaneously start continuous renal replacement therapy (CRRT) at the initiation of ECMO to manage electrolyte balance and volume control. Other centers start CRRT based upon “classical” indications of dialysis such as volume overload refractory to diuretic therapy, hyperkalemia, or uremia refractory to medical management.

St. Louis Children’s Hospital (SLCH) is a tertiary care and national referral center for pediatric medical care. ECMO has been used to support critically ill children at SLCH for 30 years. The first patient supported simultaneously with CRRT while on ECMO was in 2008. Over time the severity of illness and survival rate of the critically ill child has increased. However, patients who require ECMO still have one of the highest mortality rates in the intensive care unit (ICU). The objective of this study is to report the clinical course and outcomes of patients who require CRRT therapy while on ECMO support. Analysis of clinical parameters at initiation and during ECMO as well as the outcomes of patients supported with CRRT while on ECMO compared to their ECMO-only counterparts will help guide and improve care.

High Throughput Single Cell Genomic Analysis
Peter E. Cavanagh, 2016, Biochemistry; Biomedical Engineering Science
David Walt, Chemistry

This project aims to develop a platform for the genomic analysis of thousands of cells at once, while still retaining single-cell resolution information. To this end, the platform will individually capture cells, lyse them, and probe their genetic information using polymerase chain reaction (PCR), or a ligation-detection method. Linking these reactions to increasing fluorescence allows researchers to simultaneously detect the presence of a number of genes for each cell in a population of thousands of cells, and gain information about relative expression levels. Thus, this tool will have applications in diagnostics and research, as it can be used to study and characterize diseases such as cancer and multi-drug resistant (MDR) bacterial infections. In fact, applying this platform to the study of such diseases may increase our understanding of how sub-populations of cells in a tissue or population may have very different genetics, and such distinctions are lost in typical cellular analysis platforms, which rely on the averaging of genetic information from many cells. Information in this regard will hopefully lead to a fuller understanding of these diseases, and thus may lead to new diagnostics, new treatments, and perhaps even new paradigms of diseases such as cancers and bacterial and viral infections. Therefore, this platform will eventually be applied to studying the genetic differences at a single-cell resolution within populations of cancer cells and MDR bacteria.
Fit for the Job: Biases and Perceptions of Leadership Performance of Gender-by-Race Groups
Joey C. Cheung, 2016, Psychology; International Relations
Jessica Remedios, Psychology

Women, especially women of color, remain woefully underrepresented in the top tier of corporate leadership (Vecchio, 2002; Catalyst, 2006). Female leaders most often cite discrimination as their significant barrier for career advancement (Carli, 2001). Through an intersectional identity perspective, the aim of this study is to examine the role of bias on evaluating leadership performance, specifically on negotiation and conflict tasks, of different gender-by-race-demographic groups.

To examine the leadership qualities, we acquired responses from student leaders belonging to one of four demographic groups (White men, White women, Black woman, Asian woman) to a negotiation task and a conflict task. Participants were presented with profiles of the student leaders; we manipulated whether the profile would accurately match the demographic information of the student leader (profile of an Asian woman when an Asian woman provided the responses) or would inaccurately match the demographic information of the student leader (profile of a White man when an Asian woman provided the responses). Participants (N = 182, Mage = 19.07, 38.7% male) were asked to evaluate how well they thought the student leaders performed on the negotiation tasks and conflict tasks as well as how they performed overall.

Our results revealed that the actual responses by White men were rated as significantly worse than women in measures of performance, perceived power, warmth, competence, and confidence. In general, participants evaluated the responses similarly regardless of the accurate or inaccurate profile conditions. Contrary to popular belief, it may be that White men are not perceived to be the most effective leaders in negotiation and conflict resolution tasks.

Short encodable peptides for rapid, selective cysteine modification
Courtney Chiu, 2016, Biochemistry; Art History
Rebecca Scheck, Chemistry Department

Antibody-drug conjugates (ADCs) are targeted cancer therapies that work by having the cytotoxic drug coupled to an antibody specific for the cancer cells. The first ADC to be studied was Herceptin® in 1992, which targeted the overexpressed Her2 receptor proteins in breast cancer. Although the therapy in theory is promising, the short half-lives of these drugs has caused setbacks to their FDA approvals. There are currently only three FDA approved ADCs and over 40 ADCs in clinical trials. One reason for this is that the linker molecule between the payload and the antibody is not always stable. Linker molecules are often coupled to cysteines in the antibody and so the reactivity and selectivity of cysteine is important to understand. We propose that the reactivity and selectivity of the cysteine is influenced by its neighboring amino acids. We test this hypothesis using a library of short, encodable peptide sequences. Hits were identified using a fluorescent probe that couples to the linker. NHS-Rhodamine was selected for its high yield and optimal pH within physiological conditions. Chloroacetamide was selected as the best linker molecule for our experiments. It was highly selective for cysteine and the SN2 reaction was slow enough to discern whether one cysteine was more reactive than another cysteine in the same amino acid. A two-step labeling method was employed in order to study cysteine reactivity since it was found that the fluorescent probe docked onto aromatic amino acids,
expediting the linker reactivity. Chloroacetamide would be already coupled to the peptide before the fluorescent probe would be added to the system. Based on our findings, there is definite selectivity based on the cysteine’s local environment.

Politics of Memory in Nicaragua
Rebecca I. Cooley, 2016, International Relations; Political Science
Peter Winn, International Relations

The 1979 Sandinista Revolution ended four decades of dictatorial rule in Nicaragua. While political violence largely subsided, the ideological contestation continued via social memory in following four decades. As each new regime came to power, by revolutionary or democratic means, the incoming government sought to delegitimize, destroy and displaced the previous administration narrative of the recent national history. This thesis analyses this phenomenon through a constructivist lens and consider the consequences of this memory battle. Through the analysis of educational materials and interviews with current university students in Managua, this study delves into the complexities of memorializing recent history.

Uranium and Arsenic Contamination of Groundwater on Navajo and Hopi Nations
Jamie R. Cordova, 2016, International Relations (global health, nutrition, environment)
David Gute/Laura Corlin, Civil and Environmental Engineering

Introduction: Up to 30% of homes on Native American lands do not have safe drinking water. An estimated 54,000 people rely on unregulated wells in this region. Our purpose was to test whether the quality of the groundwater in these wells is contaminated by uranium and arsenic.

Methods: We obtained 218 water samples between 2013 and 2015 from 164 wells identified by community members across the Navajo and Hopi Nations. Samples in 2015 (n=6) were taken only from wells with elevated uranium and arsenic levels to confirm elevated levels. Uranium and arsenic concentrations were measured using an inductively coupled plasma mass spectrometer. Well depth was known for 21% of samples. Geographic coordinates were obtained for all wells and 30-day average and cumulative precipitation data were obtained from the National Oceanic and Atmospheric Administration.

Results: Mean uranium concentration (±1SD) was 9.9±21.4 µg/L and mean arsenic concentration was 8.2±15.1 µg/L. Nearly 26% of wells had concentrations exceeding United States Environmental Protection Agency (EPA) standards (6% > the 30 µg/L uranium standard, 22% > the 10 µg/L arsenic standard, 3% > both standards). In models of log-transformed metal concentrations accounting for repeated sampling of certain wells, average precipitation was a predictor of arsenic concentration (p=0.051) but season was not a significant predictor of arsenic or uranium concentrations (p>0.05 for all tests). There was some evidence that well depth was correlated with concentrations of uranium in a curvilinear fashion and that well depth was associated with arsenic in a linear fashion. Well depth was not known for the wells with metal concentrations exceeding the EPA standards.

Conclusions: Arsenic contamination, and to a lesser extent uranium contamination, are widespread in currently unregulated wells used regularly for drinking water.
Chemical Analysis of Icelandic Subglacial Lakes Using a Custom Sensor Array
Jessica S. Dabrowski, 2017, ACS Chemistry; Environmental Studies
Samuel Kounaves, Tufts University Department of Chemistry

The ultimate goal of this project is to study subglacial hydrothermal lakes in Iceland. Beneath the Vatnajökull ice cap are three lakes, Grímsvötn and the eastern and western Skaftá cauldrons that form as a result of continuous melting of the glacier by hydrothermal activity under the bedrock. The lakes are sealed along their rims by overlying ice. Bacteria have been found in all three of these lakes; psychrotolerant species have been found in Grímsvötn, and species related to known anaerobes and microaerobes have been found in the Skaftá cauldrons. Some preliminary conclusions have been made by Marteinsson et al. about the biochemical cycles in the Western Skaftá lake, but a detailed analysis of the water column is necessary for understanding what compounds are used or produced by these extremophiles. The ions and gases in these cycles, SO4²⁻, Fe²⁺, Fe³⁺, H₂, CO₂, and other ions commonly found in lake systems such as Na⁺, K⁺, Cl⁻, Ca²⁺, and Mg²⁺ will be analyzed by in situ measurements with an array of ion-selective sensors and gas sensors that can withstand the high pressures, low temperatures, and highly sulfidic environment of the lakes. This array will be tested in other lakes with anoxic zones such as Trunk River Pond in Massachusetts. The impacts of this project are potential comparisons of the subglacial lakes to chemolithotrophic habitats elsewhere, such as the oceans of Europa and Enceladus, and development of robust sensors for environmental analysis in the field.

Impact of Menstruation on the Well-Being of Adolescent Schoolgirls in rural Tamil Nadu
Kyle Daniels, 2016, International Relations; Community Health
Karen Kosinski; Sarah Pinto, Community Health; Anthropology

Historically, menstruation has been stigmatized across cultures, but since 2006 menstrual hygiene management (MHM) has begun to gain traction as a new field. MHM is a multidisciplinary issue concerning health, gender, education, and the environment. Over the past ten years research has begun to inform what constitutes a hygienic, dignified MHM practice. Studies have explored how inadequate MHM can negatively impact the physical, mental, and social well-being of menstruators. Various stakeholders in the international development community are concerned that insufficient MHM is hindering female empowerment in some communities.

This thesis sought to contribute towards alleviating some of the current research gaps in the field by increasing the understanding of the impact of menstruation on the well-being of adolescent schoolgirls in rural Tamil Nadu, India. Secondary data analysis was performed on data collected by a local MHM organization from 332 schoolgirls. Analysis focused on understanding how the respondents currently manage their menstruation, how menstruation affects their schooling, and how they feel about menstruation.
Interrogating the Racialization of Indian Americans as Physicians: Exploring My Family History
Aparna S. Dasaraju, 2016, American Studies; Community Health
Jean Wu; Shalini Tendulkar, American Studies; Community Health

Indian American’s among other prevalent stereotypes are often portrayed as physicians in the United States. Such a construction is used to perpetuate the harmful idea of the Asian Americans as supposed “Model Minorities.” This piece of work examines how the racialization of Indians in America as physicians was constructed and why this narrative continues to be perpetuated. A review of Indian immigration to the United States was conducted to look for patterns in the United States’ nativist attitude and laws towards Asia and Asian immigrants, U.S. domestic labor needs and the history of Foreign Medical Graduate immigration, especially from India to the United States. This data was used to understand how the Indian physician immigrant narrative was used to fit dominant discourse that falsely portrayed Asian Americans as the “Model Minority.” This macro-history was used to contextualize the oral histories of my parents, Rajini, a small business owner and Purushothama Dasaraju, a physician, who are Indian immigrants to the United States. Both spoke to the trials of immigration, building a new life in America as they faced discrimination at work and in the public sphere. This oral history work is important in contributing to the growing body of voices of Indian Americans and to nuance our understanding of Indian American immigration and experiences. In connecting the micro-history and the micro-history, I analyzed how Indian physician immigrants’ experiences are shaped by racism, be it by immigration law or society, in the United States.

When In Doubt, Do: Constraints on Scientific Theorizing
Phuong N. Dinh, 2017, Cognitive and Brain Sciences; Philosophy
George E. Smith, Philosophy Department

Scientific theories are commonly extracted from empirical findings, yet there is often more than one way to interpret those findings. Constraints are thus employed as a bottleneck on the set of possible theories: Those that violate the constraints are eliminated from the outset. This project argues that imposing constraints without consideration for accumulating empirical data for or against those constraints could prevent one from developing a scientific theory with true explanatory power. It will do so by investigating a parallel between two instances in the history of science where constraints were challenged. The first part of the parallel draws from Newton’s disputes with Leibniz and Huygens regarding the legitimacy of gravity as the cause of observed celestial motions. In this stalemate stretching from the 1680s up until Newton’s passing in 1727, Newton’s theory failed to satisfy the constraint of action by contact, for space was supposed to be devoid of substance. The second part concerns the mental imagery debate between Stephen Kosslyn and Zenon Pylyshyn, which has been ongoing since the 1970s. In this debate, Pylyshyn rejected mental images (or depictive representations) as a possible representation of information on the basis of the computer realizability constraint – he saw Kosslyn’s theory as not truly implementable on a computer. That Newton and Kosslyn’s theories survived despite these constraints could elucidate the role of constraints in theory-building and the conditions that license a departure from them.
The Mechanism of Large-Scale CAG Repeat Expansion
Teresa Dinter, 2016, Biology
Sergei Mirkin, Tufts University Biology Department

Nearly 30 genetic diseases are caused by the repetition of a short sequence of 2-9 base pairs, known as microsatellites. These microsatellite repeats occur in humans normally; however disease symptoms become apparent once a certain repeat threshold is reached. Usually, these diseases follow a phenomenon known as genetic anticipation, in which each subsequent generation experiences increased disease severity and earlier onset, which was found to correlate with microsatellite repeat length. To study these expansions, budding yeast (S. cerevisiae) strains have been designed to carry repeats within or near selectable genes. The CAN1 cassette, used here, contains CAG repeats between the promoter of the CAN1 gene and its galactose-induced activator. This means this yeast strain will grow on a nonselective medium, but be sensitive to a medium containing canavanine and galactose. If an expansion occurs, the CAN1 gene is no longer transcribed and growth will be present on a canavanine and galactose-containing media. Here, proteins were chosen by two approaches to determine their effect on CAG repeat expansion. First, through the candidate gene approach, Yen1 was implicated as being involved in repeat expansion because of its role as a Holliday junction resolvase. Second, in an unbiased genetic screen, Los1 had two independent hits and was interesting because of its role at the nuclear pore in tRNA export since a recent study found that expanded CAG repeats were repaired at the nuclear pore. To characterize the role of these proteins, knockout strains were created of Los1 and Yen1. Yen1 appeared to have no affect on CAG repeat expansion, both in a single mutant and double mus81Δyen1Δ background. Through many experiments, it was suggested that Los1 only affected canavanine resistance and not CAG repeat expansion.

Effect of bumble bee queen body size on overwinter survival and colony establishment
Nicholas Dorian, 2016, Biology; Environmental Studies
Elizabeth Crone, Biology

In bumble bees, queen overwinter survival and colony establishment are poorly studied, relative to worker foraging. Queen body size varies across colonies and may be an important determinant of queen success during these life stages. Larger queens may benefit during overwinter survival because they can store more fat, and may be more apt at establishing colonies due to better foraging efficiency, thermoregulation, and fecundity. Here, I analyze the relationship between body size (intertegular span) and overwinter survival and colony establishment for bumble bees (Bombus impatiens). To measure overwinter survival, I evaluated changes in the distribution of body size between fall and spring. Spring queens were significantly larger than fall queens and more narrowly distributed about the mean. I estimated minimum mortality at 0.28 and the body size that maximized this probability was 7.54 mm. To measure colony establishment, I hand-reared queens in the lab under low- and high-food treatments and recorded success as whether or not a single worker eclosed. Under low food, smaller queens were significantly better at establishing colonies, but only 22% of queens successfully established. Under high food, there was no relationship between body size and success, and 36% of queens established. The loss of a relationship between body size and establishment under a high food regime suggests that smaller queens are better able to cope with low food in the early season. These findings support the maintenance of queen body size variation in bumble bees.
Our research seeks to identify and quantify major compounds that contribute to the complex series of flavors that develop over multiple infusions of fermented Chinese Pu-erh tea. We compared flavor and mouthfeel of Pu-erh tea broth that had been brewed normally to broth from the same tea that had been vibrationally agitated using a sonicator. Sonicated ripe Pu-erh tea tasted sweeter and was easier to drink than was normally brewed tea. This difference may be a consequence of released volatile aromatics dissociating with other compounds in the tea broth such as caffeine, polyphenolics, and sugars as a result of sonication. These volatile aromatics may contribute to our smell of the tea broth and consequentially to its flavor, adding to the experience of drinking sonicated tea that normally brewed tea does not involve. We also analyzed for polyphenolics (15% - 40% of tea leaf dry weight) and sugars to test for sonication-induced changes. Results from colorimetric spectrophotometry showed no significant chemical changes between sonicated and unsonicated tea. Total polyphenolic levels and glucose and sucrose concentrations remained consistent between samples. We also developed a colorimetric caffeine assay that requires fewer resources than other methods for studying caffeine such as High Performance Liquid Chromatography. With our assay that uses the dye Acridine Orange, we were surprised to find that fermented Pu-erh teas release 15-20% more caffeine in infusions than do non-fermented or raw Pu-erh teas. Since caffeine is a plant alkaloid, not known to be a product of microbial fermentation, the mechanism for enhanced caffeine content in fermented Pu-erh remains under study. We join other labs throughout the globe in studying this cherished tea from Yunnan Province, known to improve with decades of ageing, in many ways analogous to red wines.

Do Radio Jets Contribute to Driving Gas Outflows in Moderate Luminosity Type 2 AGN?
Julia Fowler M. Fowler, 2016, Astrophysics;Philosophy
Dr. Anna Sajina, Physics and Astronomy

We present preliminary results on a project examining the role of AGN-driven feedback in low to intermediate power radio galaxies. We begin with [OIII] measurements of ionized gas outflows in 29 moderate AGN-luminosity $z\sim0.3-0.7$ dust-obscured Type 2 AGN. We aim to examine the relative role of the AGN itself, of star-formation and of nascent radio jets in driving these outflows. The strength of the AGN and star formation are based on the [OIII] luminosities, and the far-IR luminosities respectively. For the radio jets, we present multi-frequency radio (X, S, and L-bands) JVLA imaging of our sample, which allows us both to constrain the overall radio power, but also look for signatures of young radio sources, including Giga-hertz Peaked Spectrum (GPS) sources, as well as small-scale jets. While radio jet-driven outflows are well known for powerful radio-loud galaxies, this study allows us to constrain the degree to which this mechanism is significant at more modest radio luminosities of $L_{5\text{GHz}}\sim10^{22}-10^{25}$ W/Hz.

Kon vino i esperansa todo se alkansa: Cuisine and Cultural Memory in the Sephardic Jewish Diaspora
Sara M. Gardner, 2016, International Literary and Visual Studies; Spanish; Hebrew minor
Gloria Ascher, Judaic Studies; ILVS

The Catholic monarchs, Ferdinand and Isabel, expelled the Sephardic Jews from Spain in 1492. Though there remains today little evidence of their existence, Sephardic Jewry once constituted an integral population in
the Islamic caliphate that ruled the Iberian Peninsula from 711 until 1492. In addition to becoming fully integrated into Islamic Spanish society’s political institutions and social fabric, the Sephardim absorbed many of the forms of food preparation, ingredients, and rituals of their Islamic neighbors, adding them to their own culinary traditions to form a new, distinctly Sephardic food culture. After the Sephardim left Spain and resettled in various locations, they used food as a tool of cultural integration and religious preservation as well as a way to access the emotional ties to their distant lost homeland. Their cuisine became the medium through which they maintained their heritage, identity, and cultural memory even as they explored and adapted new culinary elements gained from their settlement in foreign communities. The extent to which the Sephardim successfully assimilated into their new societies while maintaining their unique cultural identity is thus evidenced in the dishes, recipes, and food rituals that the Sephardic Jews in those locations prepared and in which they partook. In my project “Kon vino i esperansa todo se alkansa: Cuisine and Cultural Memory in the Sephardic Jewish Diaspora,” I explore the multivalent processes of migration, assimilation, and cultural retention in the Sephardic Jewish diaspora using food as my focus. I study Sephardic culinary traditions as they changed specifically in Italy, the Netherlands, the Ottoman Empire, Morocco, and Curaçao after 1492. By conducting literature-based research about the Sephardic dispersion and by recreating recipes from these five distinct geographic destinations, I elucidate how Sephardic cuisine changed in each location and what these transformations can reveal about the greater diaspora. In so doing, I illustrate food’s critical role in shaping and preserving communal connection and cultural identity.

The Social Medium Is The Message: An Analysis of Social Media Marketing and How Measuring Social Media Marketing Success & Media Theory Align
Jennifer F. Gewant, 2016, Economics; Film and Media Studies
Julie Dobrow, Film and Media Studies

This project assessed how pioneering media theories, developed in an era of broadcasting to apply to radio and television use, might relate to an era of narrowcasting, in which social media increasingly dominate. Social media have altered traditional ways that organizations advertise and market products, but it’s not entirely clear whether their use may simply be new applications of old theories about how audiences perceive and receive messages - even if the form of the message is more individualized and appears on a different platform. Understanding the intersection of the practical and theoretical can help marketers innovate for the future while remaining effective in their practices.

Aspects of social media use can be explained through the ideas of media theorists like McLuhan, Boorstin, and Cialdini. At the center of social media marketing is an attempt of a brand to form a relationship with a consumer. To achieve this, businesses put out content to foster this relationship. They also receive content, which is an opportunity to listen to their consumers and demonstrate customer service.

In my analysis, I sought to find out if social media could be seen as a sustainable media outlet for the exchange of information and entertainment. Why is there an information boom, in which content is created by users and put on the web to share with a wide net of every day? And why does the information boom respond so positively to the infiltration of social media in our society. McLuhan argued that “the medium is the message,” and I also question which of the following is more important: the act of being on the medium of social media itself, or simply the message, or the content that is placed on social media?
**Novel Detection Methods for Tuberculosis Proteins**
Max N. Goder-Reiser, 2017, Biology  
Charles Mace, Chemistry  

Mycobacterium tuberculosis – the bacteria responsible for tuberculosis (TB) – presents a significant global health threat. Tuberculosis is an airborne disease and can be easily spread in its early stages when it often goes misdiagnosed or undiagnosed. According to the World Health Organization (WHO), approximately one-third of the world has latent TB and there is a high mortality rate for the majority of patients who develop active TB. Immunocompromised patients, such as those with HIV/AIDS, have the highest risk of developing active TB. Tuberculosis is most prevalent in sub-Saharan Africa and Southeast Asian nations, as they are areas that lack the infrastructure to easily detect TB. Current detection methods require both trained healthcare professionals and advanced equipment, and often require days to diagnose the disease. The goal of this project was to develop an alternative detection method for TB that was rapid, low-cost, accurate, and more accessible. The platform for such a device was a paper-based microfluidic device that utilized VHHs, heavy chain only antibodies engineered in camelids, to detect TB antigens. Progress has been made in the detection of tuberculosis antigens, primarily CFP-10, on paper. The limit of detection (LOD) in our paper-based microfluidic device was approximately 400 ng/mL. However, the engineering of higher affinity VHHs has the potential to lower the LOD by an order of magnitude or greater.

**Two-Photon Microscopy for Non-Invasive Metabolic Monitoring of Neurons and Astrocytes**
Yusi Gong, 2016, Biomedical Engineering  
Irene Georgakoudi, Biomedical Engineering  

Although much in vivo brain research has been performed on animal models, the behavior of cells in vitro is poorly characterized. 2D and 3D neuron and astrocyte models have been used in countless studies, but little is understood about how they function and behave when compared to in vivo models. This limits the ability for many of these studies to translate to the clinic. Thus, the ability to characterize how neurons and astrocytes behave on their own, and how they influence one another, is needed. Here, we propose two-photon fluorescence imaging of neurons and astrocytes within this functional model to quantify metabolic interactions between the two cell types. Two-photon fluorescence imaging is a powerful non-invasive tool that is used in functional metabolic studies by gathering signal from endogenous fluorophores. We will obtain redox ratios comparing NADH and FAD content of neurons and astrocytes to better characterize how cells behave on their own as well as when working in tandem in order to provide a better fundamental understanding of in vitro brain cell cultures.

**Insights into water dynamics at mineral surfaces**
Zachary A. Graziano, 2017, ACS Chemistry  
Yu-Shan Lin, ACS Chemistry  

Heterogeneous ice nucleation commonly occurs on mineral dusts in clouds. While the ice nucleating activity of specific minerals has been investigated, the features of specific minerals that cause them to exhibit increased nucleation ability over others have yet to be identified. Moreover, the molecular-level mechanisms by which ice nucleation occurs at mineral surfaces largely remain uncharacterized. We investigate water behavior at the surfaces of several minerals using molecular dynamics simulations. From the results of these simulations,
we have gained insights into surface features affecting ice nucleation. These insights may inform the design of hyperactive ice nucleating agents.

**Biopolitics, Space and Race: The University of Chicago’s Strategic Relationships with the South Side**
Joyce H. Harduvel, 2016, American Studies
Matt Hooley, American Studies

“Biopolitics, Space and Race: The University of Chicago’s Strategic Relationships with the South Side” is a critical history that addresses the relationship between the University of Chicago and surrounding neighborhoods and in particular its expansion into and disinvestment from the local community. It is an examination of the institutional power and biopolitical technology of the University of Chicago, and how it has been used against the neighborhoods in which the University is situated. Using archival research and geospatial analyses, the project details how the university molds Hyde Park and Woodlawn to its own benefit and the community’s detriment through three key tactics: land acquisition, private policing and provision of medical care. It also foregrounds the actions of local activists, who have in some instances been able to force the University to meet community needs. The focus of this paper is to explore the reciprocal relationship between university development and community harm through these three interactions with a particular focus on subverting the university’s narrative of its positive impact on Hyde Park and Woodlawn.

**Juniper - A Functional Reactive Programming Language for the Arduino**
Caleb A. Helbling, 2016, Computer Science
Samuel Guyer, Computer Science

Arduino is a popular platform for both hobbyists and commercial users for rapid hardware prototype development. Its popularity stems from its versatility, low cost, and low power usage. The Arduino website claims to have a “simple, clear programming environment - The Arduino Software (IDE) is easy-to-use for beginners, yet flexible enough for advanced users to take advantage of as well. For teachers, it’s conveniently based on the Processing programming environment, so students learning to program in that environment will be familiar with how the Arduino IDE works.”

Unfortunately, the statement’s validity is questionable at best. Arduinos are currently programmed in C or C++, which is not only very low level but has considerable trouble handling timing based events. Moreover, in many cases, programming in the current model does not scale well from small projects to bigger projects. As soon as more components are used, the code needs to be significantly restructured. The programming models provided by the C/C++ languages simply do not match the problem domain.

We created Juniper, a functional reactive programming language tailor-made for programming the Arduino. An Arduino program typically consists of a set of state machines with transitions triggered by events, some of which are timing dependent. The goal of Juniper is to provide a programming language which better models the problem domain. The Juniper language is easy to use for novice programmers, provides greater capabilities to experienced users, and allows the difficulty in programming bigger and more complex projects to scale properly.

Cassidy A. Heverling, 2016, Sociology; Community Health
Rosemary Taylor, Sociology

We live in a world where science has been internationalized and responses to health problems are evidence-based - or are they? In order to determine the truth of this statement, I studied the flow of scientific information throughout the Ebola outbreak in West Africa and whether/how it became factored into policy decisions designed to contain the epidemic. The broader question that interested me was the current state of global health governance and how it shapes the relationship between science and policy in the response to epidemics. I focused on Ebola as a “natural experiment” or case study which provided insight into the flaws and successes of international crisis management and preparedness for disease outbreaks, particularly concerning conflicts over standard of care, the interrupted timeline for vaccine development, and the dissemination of scientific information.

Mechanical characterization of electrogelatated silk-coated platinum microwires

Emily J. Hickmott, 2016, Biomedical Engineering
Fiorenzo Omenetto, Department of Biomedical Engineering

Previous studies [1] of the fabrication of brain-penetrating devices have examined the applicability of applying a silk coating to brain electrodes. These studies hypothesized that a silk coating on the electrode would decrease the glial response of the brain tissue because of increased biocompatibility as well as allow for more control over the characteristics of the electrode. These studies found that the use of silk as a coating material allowed for various fabrication techniques for the electrodes, controllable solubility, and hydration-dependent mechanical properties for the electrodes along with a reduction in glial scarring, especially when the silk was imbibed with the anti-inflammatory drug chaABC [1]. However, the process of coating the electrodes with silk was time-consuming and often failed to significantly coat the wires.

In this experiment, we examine electrogelation as a coating method for electrode microwires for eventual use in deep brain stimulation. We hypothesize that altering the following parameters: the boil time of the silk, the silk concentration and the electrogelation coating time will allow for more standardized procedure in applying silk coatings to wire electrodes. Once coated, the electrodes will have an altered mechanical strength and degradation time. By measuring the lateral diameter and the effect of different parameters, the functionality of the silk coating will be characterized by measuring the solubility of the silk-coated electrodes and the mechanical strength of the silk-coated electrodes. By experiment’s conclusion, the effect the boil time, concentration, and time of coating have on any given thickness, degradation time, and strength will be characterized.

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Machine Learning In Graphical Programming Languages
Harper Hopkins, 2019, Computer Science (Engineering)
N/A, N/A

Machine intelligence and genetic learning algorithms (GLAs) are some of the most important subjects in modern computation. As such, educating current and future generations on these methods is invaluable to our progress as a computationally literate society. This study sought to investigate whether meaningful problem solving by GLAs could be implemented in a simple graphical programming language that could be used to teach programming concepts to elementary, middle, or high school students. A simple physics environment was implemented in the Scratch 2.0 graphical language along with a GLA meant to solve a simple movement puzzle. The puzzle involved attempting to move through an obstacle course consisting of several barriers which a ball jumped over. Several variations of the GLA, each with slightly different parameters, were tested. The GLAs attempted to optimize initial horizontal and vertical velocities at each jump to clear the course as quickly as possible. In the three variations presented here, the algorithm made significant progress towards an optimized solution in 2,250 generations of only 2 organisms per generation. This result shows that simple GLA implementations in graphical programming languages accessible to elementary, middle, and high school students can produce useful and near-optimal solutions to physics problems in relatively few, small generations. This implies exciting opportunities for student learning and research in pre-college education.

Tissue resident $\alpha\beta^+$ and $\gamma\delta^+$ CD3+CD4-CD8- DN T cell development is independent from MHC Class I and Class II expression.
Imtiyaz N. Hossain, 2017, Biology
Dr. Joerg Ermann, Brigham and Women's Hospital

Spondyloarthritis (SpA) is a family of inflammatory rheumatic diseases with inflammation in the spine, peripheral joints, skin, intestine and other organs. Sherlock et al. provide experimental evidence in mice suggesting that SpA is mediated by tissue resident CD3+CD4-CD8- DN T cells. These cells were shown to produce the pathogenic cytokine IL-17A in response to stimulation with IL-23 in vitro, and systemic overexpression of IL-23 using minicircles resulted in spondyloarthritisc-like disease in mice. It remained unclear if the tissue resident CD3+CD4-CD8- DN T cells producing IL-17A are $\gamma\delta$ or $\alpha\beta$ T Cell Receptor (TCR)+ cells and whether their development and function depends on interaction with Major Histocompatibility Complex (MHC) molecules. In a pilot experiment and as a prerequisite for future studies, gene expression analysis was done on inflamed digits and confirmed that IL-17A is strongly upregulated in minicircle-injected mice. Lymphocytes were then isolated from the Achilles tendon enthesis and additional organs of non-injected wild type, MHC Class I, MHC Class II and $\gamma\delta$ TCR deficient mice and analyzed by flow cytometry. Results showed both $\alpha\beta$ and $\gamma\delta$ TCR+ CD4-CD8- DN T cell to be present. Furthermore, the frequency of TCR+ DN T cell populations was not affected in MHC Class I and Class II knockout mice, suggesting that the development of this rare subset is MHC independent.

Active Matter on Deformable Surfaces
Ian M. Hunter, 2016, Physics
Prof. Tim Atherton, Physics and Astronomy

Two universal components in cellular biology are soft membranes, and components which turn nutrients into motion. Active matter, which turns supplied energy into correlated motion is still a new topic of study in
physics, only understood reliably when fixed to effectively unchangeable surfaces, or in a liquid. Though analysis of the interplay between liquids, and soft membranous surfaces, and active matter have been pursued, a larger theoretical framework which allows one to predict the behavior of a variety of active matter along deformable surfaces is yet to be created.

As an analytical framework which allows one to do so may be impossible, a computational model could serve the same end. Such a model would allow users to observe how active particles on a surface deform the surface over time. Further a computational model will allow the testing en mass of the impact of varying the number of active particles, the speed at which they move, and other variables controlling their behavior on changing the evolution of deformation of the surface.

The results of a computational model of deformable surfaces compared to experiment, and analysis of the bacteria flocking on a hard sphere will be featured in the poster to be shown. It will be shown how capable the computational model is at modeling both the deformation of both liquid, and soft solid surfaces. The unique behavior of bacteria flocking will illustrate not only new results in the field of active matter, but the potential of active matter to deform surfaces in unique predictable manners depending on the type of active matter.

Epidermal Growth Factor Receptor Inhibition for Targeted Neurofibromatosis Therapies
Alexander R. Jeremiah, 2017, Biology; Spanish
Karen Cichowski, Brigham and Women's Hospital Division of Genetics

Neurofibromatosis is an inherited cancer predisposition syndrome caused by genetic loss of the NF1 gene. This loss of wildtype NF1 causes patients have an 8-13% lifetime risk of developing malignant peripheral nerve sheath tumors (MPNSTs) and there are currently no effective therapies for NF1 patients. In MPNSTs, the receptor of epidermal growth factor (EGFR), a receptor tyrosine kinase, is often overexpressed and we postulated that this could serve as a potential therapeutic target for patients. We aimed to inhibit EGFR using various EGFR inhibitors. It was expected that such inhibitors might block the activation of EGFR and therefore the downstream RAS pathway by preventing autophosphorolation of the EFRG dimers. Human MPNST lines were employed to test the efficacy of EGFR inhibitors against EGFR and other downstream targets. We found that, EGFR-specific inhibitors had little effect on proliferation compared to drugs that inhibit both EGFR and HER2, another receptor tyrosine kinase. Afatinib, one of the dual inhibitors, had the greatest effect on proliferation. Interestingly, another dual inhibitor, Lapatinib, has also shown to have an inhibitory effect on cell proliferation. In conclusion, this suggests that both EGFR and HER2 contribute to proliferation of MPNST cells. Currently, we are examining this relationship further using genetic approaches via siRNA and EGFR/HER2 inhibition in combination with other known downstream inhibitors to explore new therapies for neurofibromatosis patients.

Characterizing the Function of Habenular GPR-X: A Pilot Study
Sarah Kalinowski, 2016, Biopsychology
Luis de Lecea, Department of Psychiatry and Behavioral Sciences, Stanford University

A novel G-protein receptor, GPR-X, is an orphan receptor that is localized to a region of the midbrain called the medial habenula (MHb), known to regulate negative motivation and reward pathways. Mutations in GPR-X have been linked to depression, ADHD, and schizophrenia, although the specific function of this receptor
is still unknown, so an understanding of this receptor may lead to pharmacological treatments of these disorders. Therefore, the present study aims to deduce the role of GPR-X-expressing neurons in reward and motivation pathways and behaviors. We stimulated GPR-X-expressing neurons in the MHB of two male Tachykinin Cre mice using optogenetics, as Tachykinin is co-localized with GPR-X. Real-time place aversion and conditioned place aversion paradigms yielded no significant results, although trends suggest that GPR-X-neuron stimulation induced a modulated aversive response. These results indicate that cells expressing this receptor may play a role in modulating negative responses to a stimulus. Further studies will use this trend to investigate optogenetic stimulation in the same behavioral paradigms using GPR-X Cre mice to further elucidate the effect of precise stimulation of GPR-X-expressing neurons in regulation of negative motivation.

“Caesar Says, ‘Do this,’ and it is Performed”: Political Implications of the Faith of the Centurion in Shakespeare’s Julius Caesar and Antony and Cleopatra
Janna L. Karatas, 2016, Political Science; Spanish
Professor Vickie B. Sullivan, Tufts University, Department of Political Science

Shakespeare’s use of Biblical allusions in his works "Julius Caesar" and "Antony and Cleopatra" may, at first blush, seem to be commonplace: after all, Shakespeare evokes the familiar language of scripture in each of his works, thereby offering Elizabethan audiences a deeper, nuanced understanding of his plays. Such allusions in Shakespeare’s aforementioned Roman plays, however, highlight the ironies of the historical fate to which Ancient Rome was soon to succumb: the anachronistic references to scripture actually serve as a portent of the imminent rise of Christianity, the spread of which was to challenge the religious and political authority of the Roman Empire itself.

It is no wonder, then, that scholarship overwhelmingly emphasizes the use of Christ imagery – though anachronistic to Ancient Rome – in Shakespeare’s representation of Julius Caesar’s character: referring to the events related to Christ's birth Caesar is “as constant as the northern star”; similarly, Caesar partakes in a “last supper” of sorts and is killed after a close follower betrays him. I have identified, however, two Biblical allusions (specifically pertaining to the story of the Faith of the Centurion as found in Matthew and Luke) that challenge the dominant narrative of Caesar-as-Christ, suggesting instead that Shakespeare’s Caesar should be interpreted as a historical figure and nothing more: that is, a mortal Roman general who, despite enjoying an unprecedented degree of power, could nevertheless exercise only a limited degree of agency over his circumstances.

After researching multiple editions of the Bible from Shakespeare’s time, as well as archives at the Folger Shakespeare Library, I argue that, like the centurion of the New Testament, Caesar seeks his sick servant—in this case, the ailing Roman state—to be healed for the opportunistic purpose of continuing to serve him. Indeed, I argue that this particular allusion suggests Shakespeare’s portrayal of Caesar is that of an enslaver of the Roman republic.

Targeting a “hot loop” in the oncogenic Skp2-Cks1 protein-protein interaction with cyclic peptide inhibitors
Caitlin M. Keenan, 2016, Biochemistry
Joshua Kritzer, Chemistry

Ubiquitin ligases are enzyme complexes that tag cellular proteins for degradation. Skp2 and Cks1 are two protein subunits of a ubiquitin ligase that form a pocket to specifically bind and recruit a protein called p27
for degradation. p27 normally inhibits CDK2 (cyclin-dependent kinase 2), an enzyme that phosphorylates retinoblastoma protein and thus leads to progression from G1 to S phase of the cell cycle. In certain types of cancer, including breast, colon, prostate, and endometrial, p27 is excessively degraded. This leads to heightened CDK2 activity and faster progression through the cell cycle, culminating in abnormal proliferation. Blocking the interaction between Skp2 and Cks1, the two proteins that recognize p27 for ubiquitin-mediated degradation, could counteract this oncogenic process, raising p27 levels and slowing progression through the G1 checkpoint of the cell cycle. LoopFinder, a search algorithm developed by the Kritzer Lab, identified a “hot loop” in the Skp2-Cks1 interaction, which consists of a four-amino acid region of Cks1 at the Skp2-Cks1 binding interface that contributes heavily to the interaction. Potential competitive inhibitors of the interaction will be developed by synthesizing short peptides mimicking the “hot loop” sequence and cyclizing them with a variety of linkers to serve as conformational constraints. These potential inhibitors will be tested for their ability to disrupt Skp2-Cks1 binding using in vitro biochemical assays including isothermal titration calorimetry (ITC), ELISA, and a bead-based AlphaLisa assay.

**Characterization of Gene Expression by Diabetic foot ulcer-derived fibroblasts after Reprogramming to iPSC**

Palak Khanna, 2018, Community Health, South Asian Studies, Pre-Medicine

Dr. Jonathan Garlick, Tufts Department of Cell, Molecular, and Developmental Biology, Tufts Sackler School of Graduate Biomedical Sciences

Failures of the normal wound healing process are one of the major causes of mortality in diabetic patients. Between 6 to 8 million diabetic patients develop chronic skin ulcers each year that result in delayed or impaired wound healing, often resulting in amputations – especially in developing countries. To develop novel and more effective treatments, it is necessary to investigate the differences between the normal and diabetic wound healing processes. One of the properties of normal wound healing is the activation and proliferation of dermal fibroblasts that synthesize and secrete an array of proteins that facilitate communication between skin layers and regulate the formation of a new extracellular matrix (ECM) over the wound. However, these functions are compromised in fibroblasts found in diabetic wounds. Since these dermal fibroblasts serve as integral facilitators of the wound healing process, a potential therapy to heal chronic wounds would be to isolate fibroblasts from diabetic patients and alter their epigenetic profile to express genes that transforms them to competent cells. This would require reprogramming fibroblasts from chronic wounds into pluripotent stem cells which could then be subsequently differentiated into fibroblasts.

The overall goal of this study is to compare the activation of the genes responsible for normal wound healing in pre and post programmed fibroblasts derived from diabetic patients with and without foot ulcers. Hypothesize that the genes essential to normal wound repair will be differentially expressed in diabetic foot fibroblasts before and after programming. After programming, the proteins expressed in fibroblasts derived from diabetic patients will resemble normal foot fibroblasts more closely. To test this hypothesis, real-time Polymerase Chain Reaction (RT-PCR) and Western Blot analyses will be performed to amplify each gene of interest that will allow levels of gene expression to be monitored.
A Snapshot of Guatemalan Children's Health: A cross-sectional study examining the impact of nutrition on enteric disease and on growth in Guatemalan children from different populations, using the 1995 DHS survey data

Jordan D. Klein, 2016, International Relations; Biology
Professor Janet Forrester, Tufts University School of Medicine Department of Public Health and Community Medicine, Nutrition and Infection Unit

The Demographic and Health Surveys Program (DHS) conducts household-level surveys in developing countries to collect comprehensive family health data, usually on a decennial basis. However, due to internal political instability, the most recently comprehensive DHS family health data from Guatemala was collected in 1995, towards the end of the country's decades long Civil War. After two decades, a comprehensive DHS survey was conducted in 2015, and the data collected by this survey is expected to be released later this year. In order to effectively contextualize this data and measure the change in Guatemalan society since the conclusion of the Civil War, a baseline using the 1995 DHS data needs to be established, especially regarding the health status of Guatemalan children, which differed vastly between different social strata at the time.

Using the 1995 Guatemala DHS data, a cross-sectional study of children, stratified by ethnicity and location of residence, was conducted, examining the impact of changing nutritional intake as children age on enteric disease and on growth. Preliminary findings suggest that as children age, they are weaned off of exclusive breastfeeding and new food and drink are introduced, increasing the risk of enteric disease and decreasing growth, more significantly in rural than in urban populations and in indigenous than in ladino (mestizo) populations. This effect may be attributable to heavier reliance on exclusive breastfeeding of neonates in rural and indigenous populations and the water subsequently introduced infant diets in these populations being more likely to come from potentially contaminated sources. However, as children further advance in age and acclimate to non-breastmilk derived sources of nourishment, the trends towards higher risk of enteric disease and slower growth are mildly reversed in all populations. Future studies conducted with the 2015 DHS data can examine how these trends have changed along with the wider changes in Guatemalan society over the past twenty years.

Flip-flopping Politicians; How Voters Punish and Reward a Changing of Opinion

Sophie Laing, 2016, Political Science; French
Deborah Schildkraut, Political Science

My thesis examines how voters respond to politicians who flip-flop on their opinions. In particular, how the politician’s explanation for flip-flopping, as well as the gender of the politician affect how that politician is rewarded or punished for changing his or her opinion. Flip-flopping has become a harsh insult, thrown around by the media at politicians who change their opinion on a topic, often no matter the timespan. While it frequently brands politicians as inconsistent, untrustworthy, and insincere, “flip-flopper” can be a label that masks a legitimate evolution of opinion that may benefit an electorate. How voters react to politicians who flip-flop provides insight into what type of representation is valued in America, as well as what personality traits people value in their elected officials. I seek to understand how rationales given for flip-flopping and candidate gender affect voters’ evaluations of flip-flopping.

To evaluate these hypotheses I turn to four case studies (John Kerry in 2004, Kirsten Gillibrand in 2009, Mitt Romney in 2012, and Hillary Clinton in 2016), as well as an experimental survey. My case studies suggest
that candidates are punished for flip-flopping, and that the accusation carries with it negative trait implications. The findings of my experimental survey also reveal that flip-flopping brings with it negative trait evaluations, but suggest that the rationale a candidate gives for flip-flopping may be able to mitigate some of the negative reactions to flip-flopping. Significantly, my findings also show that candidate gender did not have as significant an effect as anticipated on voter evaluations of candidates, and that ambiguity is not necessarily a winning strategy for politicians.

**Single session Intervention teaching incremental theories of personality strengthens physiological recovery from social stress**

Eun Youb Lee, 2018, Biology; Cognitive & Brain Sciences; Computer Science;(minor in Philosophy)

Jessica Schleider, Harvard Lab for Youth Mental Health

Background. This poster will present findings from an ongoing randomized-control trial, being conducted at the Harvard Lab for Youth Mental Health, on which I have served as a research assistant since September, 2015. This study tested whether single-session intervention teaching incremental theories of personality (the belief that one’s personality is malleable) predicted adolescents’ physiological responses to social stress in at-risk adolescents (N=96, ages 12-15). Previous studies have not only shown that children with entity theories of personality (the belief that one’s personality is fixed) had higher levels of anxiety and depression, but also that teaching incremental theories of personality can improve adolescents’ resilience, including responses to social stress (Yeager & Dweck et al, 2012; Yeager, 2014). However, the factors that influence these improvements in resilience are not fully understood (Miu & Yeager et al, 2014).

Method. Adolescents were randomly assigned to receive either the incremental theories intervention or a supportive therapy. The stress induction paradigm was a modified version of the Trier Social Stress Task; participants were asked to plan and deliver a three minute speech, to a panel of observers, who appeared to be evaluating their performance. The physiological changes of the autonomic nervous system were measured throughout the stress induction paradigm as well as during a 5 minute baseline period (immediately pre-stressor) and a recovery period (immediately post-stressor) with respect to electrodermal activity (EDA), respiration rate, and the respiratory sinus arrhythmia (RSA). EDA measured the sympathetic nervous system arousal by recording the skin conductance from the sweat glands. (Critchley, 2002) Respiration rate and RSA measured parasympathetic nervous system activity by recording the naturally occurring variation in heart rate as a measure of adaptive responses to environmental challenges. (McLaughlin et al, 2015)

Knowing that adolescents with entity theory may experience distress from a wide variety of setbacks (Schleider et al, 2014), the study showed that the intervention does accelerate the rate of recovery from social stress. Furthermore, analyses are currently underway to examine whether the intervention has consistent effects on children's stress responses across other physiological metrics (RSA and the heart rate variability)

**Integrative Lessons for a Single State in Israel-Palestine**

Joseph G. Leone, 2016, International Relations

Malik Mufti, Political Science - Tufts University

Despite the increasing number of scholars, diplomats, and activists proclaiming the death of the two-state solution to the Israeli-Palestinian conflict, little attention has been spent analyzing alternative resolutions. The most prominent of these alternatives, the creation of a single, democratic state in all of Israel-Palestine, is at the center of a growing movement to move away from the failed two-state paradigm. However, little analysis
has been conducted as to what form of democratic government could best provide stability and equality to a prospective Israeli-Palestinian state.

In order to better understand the dynamics of governing across deep communal divides, Israelis and Palestinians should look towards the democratic experiences of other deeply divided societies. This thesis examines the confessional political system of Lebanon and the extent to which it has provided stability and equality to its diverse religious communities. While Lebanon was able to achieve relative stability by addressing its deep divisions and incorporating each community in the political process, the inclusive benefits of this system were consistently undermined by the inflexible distribution of political positions amongst pre-determined communal groups, with no mechanism for the system to adapt to change over time.

In response to these findings, this thesis proposes an alternative system of “dynamic consociationalism” as an effective form of governance in deeply divided societies, both Lebanon and Israel-Palestine. Such a model facilitates the incorporation of all relevant segments of the population into government yet is able to adapt to reflect both changing demographic realities and the emergence of inclusive political forces that bridge the communal divide. Although the realization of a one-state solution in Israel-Palestine may still be a distant outcome, this thesis proposes the consideration of a dynamic consociational model as a stable and integrative framework for such a unified, democratic state.

Displacement and Discipline within a Chinese City: Representation of rural migrants in The World and Beijing Bicycle
Hongjie Lim, 2016, History
Xueping Zhong, Chinese

Since the implementation of economic reforms and the increasing marketization in China, urban regions have grown tremendously in size and population as millions of individuals across the country move from the rural sector into the urban seeking employment. In this essay, I use the films The World (2004) by Jia Zhangke and Beijing Bicycle (2001) by Wang Xiaoshuai to understand rural-urban migration at the turn of the 21st century and the work of rural migrants both within the capital city of Beijing but also more broadly in many of China’s rapidly expanding urban regions. In particular, I read rural-urban migration in both films as a process of displacement and discipline within a growing capitalist economy. Many of the migrants in both films are displaced individuals in the city, not just apart from home, family, and practices that they are used to, but also made to perform identities that are incongruent with their social positions. In addition, the city also has a disciplining effect on rural migrants, pressuring them into dressing and behaving within certain expected parameters. Through a close analysis of both films, I hope to comment on the kinds of lives and modes of being that are being enabled and the kinds of lives that are disallowed and denied through the discourse of urbanization, modernity and globalization in China. To interrogate the consequences of rapid urbanization on the lives of individuals is to inquire into the nature of rapid capitalist growth and how people’s lives take on or are imbued with certain meanings within this broader context of urban development. By doing so, I hope to render visible the invisible and foreground the lives of this expansive labor force within this larger capitalist system.
Response of microglia in vivo to acute alcohol exposure
Nina M. Lutz, 2017, Clinical Psychology, Child Study and Human Development
Dr. Ania Majewska, University of Rochester Department of Neurobiology and Anatomy

Microglia are the primary immune cells of the central nervous system, able to quickly respond and migrate to sites of infection or injury within the brain. Recent research has also suggested that outside of pathology, microglia play an active role in brain plasticity. Microglial activity in both the healthy and injured brain has been extensively studied but the immediate effects of ethanol on microglial morphology and motility in vivo are unknown. Given their rapid responsiveness to both immune and environmental insults, we hypothesized that microglia may be acutely sensitive to ethanol exposure. Ethanol may trigger morphological changes indicative of activation and microglial motility may be affected. Using in vivo two-photon imaging, we were able to observe the response of microglia both immediately and 2.5 hours after a single binge-level dose of ethanol. To assess ethanol-induced changes in microglial behavior, we quantitatively analyzed both changes in microglial process motility and morphology over time. We found that ethanol triggers immediate process retraction, though there are no apparent changes in motility. Several hours after ethanol exposure, subtle changes indicate that morphology stabilizes and motility increases. These results suggest that acute alcohol exposure rapidly causes changes in microglial activity in vivo.

The effect of clathrin adaptor protein GGA3 overexpression on BACE1 in mouse brain
Martin Ma, 2016, Biochemistry
Giuseppina Tesco, Department of Neuroscience, Tufts University School of Medicine

Alzheimer’s Disease is a neurodegenerative disorder that is a leading cause of dementia in the population. The pathological hallmark of AD is the accumulation of amyloid-β protein (Aβ) in the brain. The activity of β-site Amyloid Precursor Protein-cleaving enzyme-1 (BACE1) is the rate-limiting step of the pathway that generates Aβ. Therefore, BACE1 has been used as a therapeutic target for Alzheimer’s disease. In this experiment I tested the effect of Golgi-localized γ-ear-containing ADP-ribosylation factor binding protein 3 (GGA3) on the expression level of endogenous BACE1 in vivo. It has been previously shown GGA3 inversely regulates the level of overexpressed BACE1 in an in vitro model. In this experiment, I used 3 different transgenic mouse lines overexpressing GGA3 Tg-GGA3WT, Tg-GGA3L276A, Tg-GGA3QM to test the hypothesis that overexpression of GGA3 regulates endogenous BACE1 level in mouse brain. Analyzing hemi-brain homogenate samples collected at 2 month of age, I did not find significant suppression of endogenous BACE1 level in transgenic mice overexpressing GGA3 compared to the non-transgenic control group. An alternative hypothesis was made that GGA3 only regulates BACE1 when BACE1 is overexpressed, for example in individuals with pathological phenotypes. The new hypothesis will be tested by doing a rescue experiment by introducing GGA3 overexpression to GGA3 knockout mice, which has been shown to have elevated BACE1 and Aβ level in the brain.
Predictors of Urogenital Schistosomiasis Knowledge among schoolchildren in the Eastern Region of Ghana

Rachel A. Martel, 2017, English; Community Health
Karen Kosinski; David Gute, Community Health; Civil and Environmental Engineering

Urogenital schistosomiasis (UGS) is endemic in the Eastern Region of Ghana, particularly amongst primary-school aged children in rural communities. Educating children about UGS through the public school system in endemic areas can be an effective primary preventative intervention that accompanies mass drug administration. However, little is known about the baseline knowledge of schoolchildren in the Eastern Region of Ghana regarding UGS, and the individual and community-wide characteristics that predict levels of knowledge. The objective of this study was to determine the baseline knowledge of students in the Eastern Region of Ghana regarding UGS, and determine the extent to which year in school, sex, and district of residence predict UGS knowledge among schoolchildren. From June 15th 2015 to July 1st 2015 a cross-sectional study was carried out among 1813 primary and junior high-school schoolchildren in public schools across 37 randomly selected towns within 10 districts in the Eastern Region of Ghana, in which all participants were given a 22 question knowledge survey on the contraction, treatment, and symptoms of schistosomiasis and protective measures that can be taken to prevent infection. A score was assigned to each student representing the percentage of questions answered correctly out of all 22 questions. Overall, the average score on the knowledge survey was 57.5%. Junior high school students had a mean score of 63.0%, while primary school students had a mean score of 51.5%. Responses indicate that knowledge of how the disease is transmitted and how the disease can be treated is lacking among both primary and junior high school students. Linear regression analyses indicate that sex, class year, and district of residence are predictive of student performance on the knowledge survey, with class year as the strongest predictor. Linear regression and chi squared analyses indicate that boys systematically perform better than girls on the knowledge survey, and junior high school students systematically perform better than primary students on the knowledge survey. These results will enable officials to plan and execute effective UGS educational interventions in the Eastern Region of Ghana.

Role of Hydroxyl Radical in Ultranano TiO2 Photo-oxidation

Jordin M. Metz, 2016, ACS Chemistry
Mary Jane Shultz, Chemistry

This project investigates the use of ultranano TiO2 (~2nm diameter particles) for use as an efficient, cost-effective photocatalyst in a water-purification system. The goal is to use sunlight and a TiO2 catalyst to oxidize contaminants in water, allowing for an off-grid system that removes chemical and biological substances to make water safe for drinking. This work investigated the mechanism of how two types of ultranano TiO2 function in water. A more detailed knowledge of the mechanism will allow for a more targeted approach to synthesis in order to generate more efficient particles, as the current particles are not efficient enough to use in a water purification system. Unmodified TiO2 and 0.5% Fe-TiO2 are the two types of ultranano anatase TiO2 that were investigated. Both particles are synthesized from TiCl4 in H2O, with the iron-doped particles containing a single iron atom in the crystal, coming from FeCl3 added to the reaction flask. The particles were irradiated with a solar spectrum lamp while they oxidized methanol to formaldehyde. Gas Chromatography-Mass Spectrometry (GCMS) was used to detect the formaldehyde concentration after the experiment. The hydroxyl radical quencher tert-butanol was utilized during some experiments to determine the relative importance of hydroxide radicals in the overall mechanism by comparing experiments that used this quencher to those that had not and calculating the decrease in efficiency based on the presence of the quencher.
The Role of Programmed Death Ligand 2 (PD-L2) in the Regulation of Immuno-pathology in Schistosoma mansoni Infection
Emily A. Miller, 2016, Biology; Community Health
Miguel Stadecker, Tufts Medical School, Department of Integrative Physiology and Pathobiology

Schistosomiasis is a tropical infectious disease caused by parasitic helminths of the genus Schistosoma. Infection with schistosomes results in a CD4 T cell-mediated inflammatory response. Tissue-lodged parasite eggs cause granulomatous inflammation resulting in morbidity and mortality in both humans and in the murine model of the disease. Infection with the species Schistosoma mansoni results in uneven liver immunopathology among different mouse strains. CBA/J (CBA) mice develop severe immunopathology mediated by Th17 cells while C57BL/6 (BL/6) mice exhibit mild immunopathology in a Th2-polarized cytokine environment. The PD-L2 - PD-1 inhibitory pathway is of interest in our study of schistosomiasis because of its known role in preventing overly aggressive immune responses. Previous lab observations have shown that when the PD-L2 gene is silenced in BL/6 mice, infected mice exhibit a marked increase in immunopathology compared with WT controls. I hypothesized that measurement of cytokine levels would show that PD-L2-deficient (PD-L2-/-) BL/6 mice had increased levels of proinflammatory cytokines associated with a Th17 response and reduced levels of anti-inflammatory Th2-associated cytokines compared with WT BL/6 controls. We now show that in the absence of PD-L2 there is an increase in pathology associated with elevated proinflammatory cytokines IL-23 and IL-17, and reduced anti-inflammatory cytokine IL-4. Interestingly, there were no observed changes in levels of proinflammatory cytokine IL-1β. These results suggest that the PD-L2 - PD-1 system is involved in curtailing immunopathology in experimental schistosomiasis.

Designing a Computer Simulation Tool for PET Neuroimaging
Thomas M. Morin, 2017, Cognitive and Brain Science; Computer Science
Hsiao-Ying (Monica) Wey, PhD., Instructor in Radiology, Martinos Center for Biomedical Imaging, Massachusetts General Hospital, Harvard Medical School

Neurochemical imaging with Positron Emission Tomography (PET) can be used to answer a host of research questions related to protein density, drug occupancy, and endogenous neurotransmitter release. Despite its capabilities, the number of considerations that are required for a PET study can make it unapproachable. Computer simulation using pharmacokinetic models is a useful method for testing experimental paradigms before putting a patient or animal in the scanner.

Traditionally, creating computer simulations for pharmacokinetic PET requires advanced mathematical knowledge and the ability to write computer code. To make these simulations more accessible to researchers from an array of disciplines, we sought to create a flexible and intuitive Graphic User Interface (GUI).

The resulting PK Simulation Tool is a fully customizable, Matlab-based GUI that allows researchers to run simulations without ever writing a line of code. With the tool researchers can predict the results of custom scan-procedures by adjusting the individual kinetic properties of a radiotracer, creating novel infusion paradigms, planning pharmacological challenges, and analyzing the data through several mathematical models. With the PK Simulation Tool, researchers can quickly simulate PET studies, evaluate their feasibility, and optimize experimental designs.
Social-Emotional Predictors of Depression in Adolescent Mothers: Impacting the Effect of Home Visiting Programs on Mothers' Depressive Symptomology

Emily Morton, 2016, Child Study and Human Development; Psychology
Jana Chaudhuri, Ann Easterbrooks, Tufts Interdisciplinary Evaluation Research (TIER), Tufts Eliot-Pearson Department of Child Study and Human Development

The present study aimed to examine how the influence of enrollment in a home visiting program on adolescent mothers’ depression varied due to their social-emotional experiences. Home visiting programs, evidence-based family-centered services in which a trained home-visitor regularly meets with the mother, have become popular a method of reaching and supporting this at-risk population, and have shown marginal ability to improve mothers’ mental health. However, little is know about how the social-emotional experiences that predict depression affect the ability of the home visiting program to decrease mothers’ depressive symptomology. Two-hundred eighty-nine (289) mothers were interviewed in-person or over the phone four times between pregnancy and when the child reached 5 years of age. Interviewers collected data on mothers’ depressive symptomology, various types of social support, quality of their childhood parent-child relationship, and reports of childhood maltreatment. Analyses included 2x2 mixed-model ANCOVAs and multiple regression analyses. Statistical trends emerged such that, among mothers enrolled in the home visiting program, their depressive symptomology depended on the dependability of their social support from friends and family and their childhood experience of maltreatment. Implications of the study include the home visiting program’s ability to improve the mental health of mothers with better support and who have not had traumatic experiences of maltreatment in childhood. Thus, the study expands upon previous research on adolescent mothers, home visiting programs, and depression, by identifying subgroups of mothers for whom the home visiting program is more likely to improve mental health.

Evaluation of silk fibroin stabilization of doxorubicin

Elim Na, 2017, Biochemistry
David Kaplan, Department of Biomedical Engineering

Chemotherapy is typically administered systemically. Due to the systemic delivery route, significant and sometimes lethal side effects may occur. These side effects often limit the maximum allowable drug dose, reducing the drug’s effectiveness. Local, sustained release drug delivery systems are a potential way to overcome this limitation. It is known that silk films can bind and slowly release doxorubicin, a common chemotherapeutic agent. However, it is not known if the sustained release formats stabilize the drugs and reduce their solution degradation. This research will (1) identify potential degradation products of doxorubicin, and (2) characterize the released molecules to identify if silk materials support drug stabilization under aqueous conditions. We want to determine if the majority of the drug remains intact over the experimental time course.

Critical Daylength for Diapause Induction in European Corn Borer (Ostrinia nubilalis)

Yuta Okada, 2018, Biochemistry; Computer Science
Professor Erik Dopman, Department of Biology
Arab-American Activism and Community Building in Boston during the Lebanese Civil War
Katherine Okker-Edging, 2016, International Relations; Arabic
Thomas Abowd, German, Russian and Asian Languages & Literatures

This research explores Arab-American activism and community building in the early 1980s, during the Lebanese Civil War and the Israeli Invasion of Lebanon. On a national scale, I study the development of several major Arab-American organizations, who worked during this time to bring together the community across the United States. In addition to national activist efforts, I have specifically explored the activities of the Boston Arab-American community during this time. I focus on the reasons and motivations behind the use of media (particularly television) as a way to advance political and cultural themes and identities. Using the Arabic Hour, a local English-language television program based in the area since 1981, as a case study, I have explored how Arab-Americans in Boston responded to these events in the Middle East through cultural, political, religious, and educational activism. I have also looked at how individuals in Boston define their work and activism in different ways, all with the same goal of building community and providing support to those at home and abroad during a difficult time. This project uses qualitative interviews as well as Arabic Hour episodes in order to explain the role that these types of activism had on the Arab-American community during the Lebanese Civil War.

Dielectric measurements of carbon nanotube doped nematic liquid crystals
Matthew Peterson, 2016, Engineering Physics
Peggy Cebe, Department of Physics and Astronomy

We studied the effects of carbon nanotubes (CNTs) on the dielectric properties of nematic 5CB liquid crystals (5CB). Samples containing 0.01%, 0.10%, 0.20%, and 0.50% CNTs were prepared. Indium tin oxide (ITO) glass cells with a nominal thickness of 10 μm and a polyimide alignment layer were used for testing. The capacitance and dissipation factor were measured using an agilent 4284A precision LCR meter. From these measurements, the complex dielectric permittivity was calculated. The permittivity in the low-frequency regime (f < 1 kHz) is strongly dependent on CNT concentration, with samples containing higher concentrations exhibiting a more prominent relaxation process. The Fréedericksz transition critical voltage was noted by a sharp increase in the capacitance after an initial plateau. Numerical simulations of CNT-facilitated switching show that induced polarization of the nanotubes from capacitative effects can significantly reduce the critical voltage in DC electric fields, in agreement with preliminary experimental results. Measurements of the critical voltage over a range of frequencies will also be presented.

The Impact of User Interface on Young Children's Learning Experiences and Acquisition of Computational Thinking Skills
Alex M. Pugnali, 2016, Engineering Psychology; Child Study & Human Development
Marianna U. Bers, Eliot Pearson Department of Child Study & Human Development

This study aims to assess the kinds of learning experiences that happen and skills that are gained when young children learn computational thinking through tangible versus graphical interfaces. DevTech Research Group at Tufts University has created two products, the KIBO Robotics kit and ScratchJr app, to teach computational thinking skills to young children (4-7 years old). The KIBO robotics kit engages children in learning programming by using tangible wooden blocks, (no screens or keyboards required). ScratchJr does the same, but graphically on a tablet device.
Close to the Edge: Foraging and Movement Behavior of Mice at Edges
Lauren Redosh, 2016, Biology; Environmental Studies
Elizabeth Crone, Biology

Edges between habitats are ever-present characteristics that the majority of animals (and plants) encounter. Animal behavior frequently changes at these edges. For mice, this border is typically the edge between the forest and meadow or grassland habitat. Just as the edge may impact mouse behavior, so too may behaviors impact the edge.

My senior thesis aimed to examine how foraging behavior of mice (Apodemus flavicollis, Peromyscus maniculatus, and Peromyscus leucopus) might vary along different edges and edge gradients. We used giving up densities and movement data to examine these impacts. The studies examined two edges - one in the mountains of Poland at treeline (forest turning to meadow) and the other in Harvard, Massachusetts with patches of forest surrounded by meadow. In Poland, we examined how foraging decisions, movement, and density might differ below treeline (forest habitat) and above treeline (meadow). While some questions remain unanswered, we found that density was generally higher in the forest while movement distances were longer in the meadow. This might have interesting consequences for seed dispersal by the seed caching yellow-necked mouse (Apodemus flavicollis).

In Massachusetts, we examined how the distance to the edge of the forest and environmental factors might impact foraging decisions. While we found a strong effect of one environmental factor on foraging, it is in the opposite direction as that found in existing literature. This suggests that there is some other factor contributing to our results.

Ethnicity and Self-Love in Elementary School Children
Alyssa Rivas, 2018, Interdisciplinary Major (Youth Development, Ethnic Identity and Media Socialization); Film and Media Studies
Akira Gutierrez, Institute of Applied Research in Youth Development

The Institute for Applied Research in Youth Development (IAYRD), in conjunction with WGBH has created the Arthur Interactive Media Project (AIM). AIM is a series of prosocial comics, games and interactive features to help children understand and develop language to talk about emotions. The media has been supplemented by a series of surveys and booklets for both students and teachers. Using the data from AIM and focusing on 3rd through 6th graders, the research focuses on the way that children are identifying themselves in the media they consume. The first data point that needs to be established is the relation between children’s reporting of language and ethnicity with that of their parents to categorize their “ethnicity”. Students are grouped by ethnicity as well as race, socioeconomic status, and location. By cross referencing this data with children's reporting of self love, and happiness and their media consumption, we can draw conclusions about how media consumption is related to the development of their identities. The next wave of the program will include an interview section to ask the students about how they identify, their media use, and how they view themselves. Different students of different racial groups are compared to see differentials between groups. This research examines the under-researched area of children of color and their media use and drawing ties between familial relations and its manifestation in media, school and a child’s chosen identity.
Recovering from Negative Social Situations: Post-Event Processing and Reappraisal  
Annabelle Roberts, 2016, Psychology  
Heather Urry, Psychology  

Is dwelling on negative experiences harmful or beneficial? This study uses experimental manipulation to assess the relationship between post-event processing and cognitive reappraisal. Post-event processing (PEP) is the experience of repeated reflection after negative social events, while cognitive reappraisal (CR) is the act of reinterpreting events to reduce negative emotions. We hypothesized inducing PEP would improve CR skills. Participants (n = 125) were exposed to an evaluative task (Trier Social Stress Test) and a control version in the laboratory. Two, four, and six days later participants were asked to either reflect on the stressful (negative PEP condition) or neutral (neutral PEP condition) aspect of the laboratory experience, or not asked to reflect at all (control condition). Seven days after the initial stressor, participants were instructed to demonstrate their reappraisal abilities by writing about the lab experience and a negative event from that day such that they feel less negative emotion. Participants displayed significantly more negative post-event processing in the negative PEP condition, demonstrating that the reflective writing task was successful in inducing post-event processing. Results also indicated post-event processing decreased participants’ ability to successfully use cognitive reappraisal for life events, revealing a harmful consequence of post-event processing.

Predictors of borehole functionality and implications for rural improved water coverage in Eastern Region, Ghana  
Paige E. Roberts, 2016, Applied Mathematics; Biology  
Karen Kosinski, Tufts University Community Health  

Continuous, reliable, and convenient access to improved water sources remains a problem in many parts of the world, specifically in rural communities. It is known that use of improved water sources (as alternatives to surface water or other unimproved water sources) reduces waterborne disease burden, but barriers to the use of these sources are prevalent. Challenges include installation of new improved water sources in low coverage areas, as well as sustainability of existing water sources, continuous functionality, and sufficient water quality. In this study, data were collected in 70 rural towns in the Eastern Region of Ghana with the goal of exploring relationships between functionality of boreholes with types of water payment mechanisms, perceived water quality, density of improved water sources, and ability to access maintenance services.

Of all enumerated boreholes, 78% were functional at the time of data collection, which is comparable to other studies performed in rural Africa. For each of five common water quality complaints, over 70% of interviewees reported the problem, meaning that water quality could be a major barrier to use of boreholes in this area. In addition, only just over half of the boreholes required regular payment for use, with 12% requiring semi-regular payment, and the remaining 35% requiring only highly irregular payment or no payment at all for use. Payment mechanism, distance and time to the nearest borehole mechanic, and several water quality complaints were significant predictors of borehole functionality in univariate models, illuminating these factors as major contributors to sustained use of improved water sources by rural communities. Establishing regular payment for improved water sources, connecting measurable water quality metrics with perceived water quality complaints, and mapping ground water quality must be addressed moving forward towards safe and clean water in rural areas of Ghana.
**Development of a Stable, Potent, and Durable GLP-2R Agonist**

Marissa S. Rodenstein, 2016, Biochemistry  
Krishna Kumar, Chemistry

Glucagon-Like Peptide 2 (GLP-2) is a 33-amino acid hormone in the human body. It is secreted upon nutrient ingestion by the enteroendocrine cells of the gastrointestinal tract and binds to its cognate receptor (GLP-2R), leading to beneficial effects on the intestine, by increasing blood flow and epithelial proliferation, improving nutrient absorption as well as reducing inflammation of the intestinal mucosa. Though GLP-2 is degraded rapidly (half-life ~ 7 min) by the protease dipeptidyl peptidase 4 (DPP-4), a stable analog, GATTEX® (Teduglutide) has been developed for use in the treatment of Short Bowel Syndrome (SBS), a condition that results in inadequate absorption of nutrients through the bowel due to intestinal removal, disease, or injury. Teduglutide reduces the need for the intravenous administration of nutrients, parenteral support (PS), for some patients with SBS. However, in clinical trials with daily administration, it only reduced the need for PS in about 60% of patients, and some of these individuals only had a 20% reduction in PS volume. Therefore, a superior GLP-2R agonist was developed with improved potency, durability, and stability as a potential therapeutic for SBS and other intestinal ailments. This GLP-2R agonist uses the sequence of GLP-2 with a few amino acid modifications, as well as the attachment of a lipid. It has enhanced in vivo longevity compared to Teduglutide and works well in producing gut proliferation in rodent models.

**Improving computational methods for cyclic peptide design**

Julia R. Rogers, 2016, ACS Chemistry; Biotechnology  
Yu-Shan Lin, Chemistry Department

Aberrant protein-protein interactions are implicated in a variety of diseases including cancer, leukemia, and neurodegenerative diseases. Cyclic peptide therapeutics have the potential to mediate such protein-protein interactions with higher specificity and affinity than their linear peptide counterparts. The rational design and further development of cyclic peptide therapeutics necessitates an improved understanding of their structures and furthermore, their sequence-structure relationships. Indeed, cyclic peptide structural dynamics vary greatly compared to that of linear peptides: Although the structure of a linear hexapeptide can be highly flexible, a cyclic hexapeptide typically only adopts a few conformations due to ring strain. Experimentally, cyclic hexapeptides have been shown to adopt structures with two β-turns. With a limited number of conformations, cyclic hexapeptides are ideal models to study how various types of β-turns interchange to produce different cyclic peptide structures. From molecular dynamics simulations of a highly flexible cyclic hexapeptide of all glycine, conformational switches were found to occur via coherent two-dihedral changes. These mechanistic insights into how different cyclic peptide structures interconvert have guided the development of simulation methods to more efficiently sample cyclic peptide structures.

**Responses to Ambiguous Facial Expressions in PTSD**

Lisa M. Sangermano, 2016, Psychology; Biology  
Dr. Lisa Shin, Tufts Psychology Department

Posttraumatic stress disorder (PTSD) is associated with increased arousal and exaggerated responses to potential threats. Research has used images of different facial expressions as stimuli to stimulate a threat response in participants. This study aims to determine whether individuals with PTSD perceive surprised faces as a potential threat. Surprise is an ambiguous emotion that can represent a positive or negative context. Previous studies have shown that individuals with PTSD show abnormal brain activation to fearful and angry faces.
compared to control participants, which suggests that PTSD is associated with a heightened threat response to emotional facial expressions. Therefore, we hypothesized that PTSD individuals would generalize surprised faces as a threat, and trauma-exposed non-PTSD (TENP) participants would not. Participants viewed surprised facial expressions, neutral facial expressions, and a fixation cross during an fMRI scan and then rated the arousal and valence of the facial expressions. Significant activations were correlated with ratings, as well as PTSD severity. Overall, our results showed that PTSD participants did not respond to surprised faces as a potential threat, but they did show abnormal patterns of activation and labeling when compared to the TENP group. Our results also suggest that PTSD individuals may respond more negatively to neutral facial expressions than the TENP group and that neutral facial expressions may be interpreted as a potential threat in PTSD.

Water Use in Rural Ghana: A qualitative analysis of women's perceptions of community water resources
Liliana Schmitt, 2017, Community Health; Sociology
Karen Kosinski, Community Health

This research is based on qualitative data from in-depth interviews with 50 women in the Eastern Region of rural Ghana and was analyzed to develop an understanding of why women do or do not use the water infrastructure that is theoretically available to them. Women in Ghana are the primary controllers of water resources for the household, and therefore are critical to understanding the decision-making processes involved with water source use. We consider the ways in which those who are among the most affected by safe water make use of the water resources available to them. We seek to disarticulate known patterns of water coverage from actual water use, asking how women make choices about the perceived benefits, drawbacks, and limitations of individual sources. We sought to understand women’s self-assessments of water quality and water appropriateness; how women perceive “good” water may differ from the official WHO definition of improved water. Similarly, we seek to understand the cultural foundations of water use, contrasting local definitions of “good” water with official concepts such as “improved water”. Further, we seek to understand the relationship between actual water use patterns and women’s perception of water-related health concerns.

Emergency Medical Services: A Provider’s Perspective
Montane B. Siverman, 2016, American Studies; Community Health
Frances Chew, Biology and American Studies

Receiving medical attention across the United States is as easy as picking up the phone and dialing 9-1-1. In doing so, an individual is activating emergency medical services. Within minutes, trained medical professionals arrive at any location ready to deliver lifesaving interventions and provide transportation to an appropriate medical facility. Despite the contributions to society and benefits that emergency medical services confer, the system and its providers remain disorganized, understudied, and relatively misunderstood. This study works to understand paramedics’ attitudes towards and perceptions of their profession. This research intends to investigate the personality of these providers, their interpretations of the public’s perception of emergency medical services, as well as the causes and implications of occupational stress. Utilizing a qualitative study method, in-depth interviews were conducted with five paramedics representing varying years of experience as well as both private and public sector involvement. It was ultimately found that paramedics are characterized by a caring nature and the belief that the public lacks an accurate understanding of emergency medical service capabilities. In addition, the paramedics interviewed expressed beliefs that the emergency medical service system as a whole places stress on the providers by the limited career features and opportunities that
it affords. Based on these results, a foundation has been laid for further inquiry into the lives, perceptions, and motivations of those who answer the call for medical emergencies.

**Sexual Harassment in the Workplace: Evidence from Better Work Participating Factories**

Claire O. Sleigh, 2016, Economics; International Relations  
Drusilla Brown, Economics

Sexual harassment is a significant problem in apparel factories, but recognizing and addressing it is challenging because workers frequently misunderstand what sexual harassment is, are unaware of their rights, or are too discouraged or scared to report it. Not only is sexual harassment morally reprehensible and illegal in most countries, it has been found to reduce worker productivity and has the potential to reduce firm profits. My research looks at factories participating in the Better Work program, an international group that seeks to improve labor standard compliance, and uses data from Better Work and researchers in the Tufts Economics department. The goal of the econometric analysis is two parts, first to understand why sexual harassment happens (and by extension what factory characteristics limit harassment), and second to see the effect of Better Work on harassment.

Using the theoretical model developed by Xirong Lin, Laura Babbitt, and Drusilla Brown, this paper tests several theories by looking at specific factory characteristics and the nature of the relationship between workers and supervisors. Organizational awareness of sexual harassment and norms against it both limit the extent of sexual harassment. From surveys of workers in Better Work participating factories in Jordan, Indonesia, Haiti, Vietnam and Nicaragua, we see evidence that compliance visits in the factories have decreased sexual harassment in most countries and that the dominant trend is toward improvement over time. Specific training conducted in Jordan also decreased the instances of sexual harassment.

**Banned In Boston: Censorship and Self-Censorship in Boston's Federal Theatre Project**

Sarah C. Vandewalle, 2016, Drama  
Heather Nathans, Drama

The Federal Theatre Project (FTP) created jobs for thousands of theatre artists, and entertainment for millions of suffering Americans through the ingenuity of the federal government and the Roosevelt administration. Boston was conceived as one of five major centers of this project. However, the city’s FTP chapter suffered from the longstanding tradition of censorship put in place decades beforehand by conservative cultural groups and authorities. An early encounter with this censorship apparatus during their first major production, Valley Forge, created a poor reputation for the Boston chapter. Though the national FTP strived to produce plays with social and political importance to the communities they performed in, Boston’s company continually failed to do this because of an established system of censorship. This system both restrained the company externally, through outwardly visible legal and social means, and internally, by forcing the company to self-censor themselves.

In order to avoid censorship or controversy, the Boston FTP repressed controversial material through play choice, script revision, and promotion. Their first major production, Created Equal, saw each of these actions, and was consequently stripped of much of its radical character. Revisions and promotions toned down any mob uprisings or “communistic tendencies,” in a time when Boston was dealing with unemployment uprisings and strikes. Ads focused on the patriotic history of democratic America instead of any calls for uprising, since communists were hunted down in courts across the nation. Created Equal was portrayed as a
wholesome and uncontroversial production that the Boston FTP could produce without consequence from the censorship apparatus. Because of this, it and other plays like it missed their radical potential and could not carry out the activist goals set by the national FTP, and instead catered to Boston’s status quo.

**Homeownership and Wealth Accumulation: Evidence from the PSID**
Allison Wainer, 2016, Quantitative Economics
Jeffrey Zabel, Tufts Economics Department

My research uses household level data from the Panel Study of Income Dynamics from 1999 to 2013 to determine whether low income households accumulate more wealth by owning or renting their homes. Controlling for household fixed effects and stages in the housing market, I find that an increase of two additional years of homeownership leads to a 20% increase in wealth, on average, for all households, including those in the lowest income quartile. Additionally, a majority of this increase in wealth seems to occur in the first two years of ownership, which may be due in part to the Great Recession of 2007-9. These results suggest that homeownership is a reliable way for households to accumulate wealth, but they must be ready to face significant losses, as home equity decreased over the study period for many households.

**Youth Sport, Masculinity, and Critical Education**
Nicholas Whitney, 2016, Sociology
Sarah Sobieraj, Sociology

While organized sport has been studied as a potentially positive developmental context for youth (Holt 2008), many sociologists and masculinity theorists suggest it is a context that reinforces deeply ingrained beliefs about gender and gender inequity and can tacitly promote heteromasculinity through the devaluation of femininity and queerness (Connell 2005; Messner 2007). As such, those committed to social justice through education need an understanding of how inequities persist within these contexts and how to incorporate this knowledge into school curricula.

This poster uses qualitative data collected from in-depth semi-structured interviews with workers at a national non-profit who promote "positive sport culture" through education in high schools. Using several stories from these data, this poster suggests the presence of overt and covert mechanisms of power that may promote heteromasculinity and, in the process, devalue women, queerness, and expressions of femininity in sport, despite progress within the institution of sport. Indeed, all of the participants discussed multiple experiences characterized by violence or aggression (including abusive coaches), by institutional inequities (including the fight for equitable funding), or by tactics to exclude an athlete or athletes from participation (including both overt and covert sexist and/or homophobic remarks among peers and coaches). These highly gendered experiences suggest the presence of structural inequities within sport, and necessitate an interrogation into mechanisms of power that continue to operate within sport organizations and schools. Indeed, these participants’ experiences suggest both the ability and need to adapt a critical curriculum for high school athletes.

**Race, Gender, and Health: How Men of Color Engage in Public Health Programming**
Charles T. Wiebe, 2016, Economics; Community Health
Shalini Tendulkar, Community Health

Studies suggest that men have poorer health across a range of indicators as compared with women, with men of color experiencing an even more disproportionate burden, particularly related to cardiovascular disease
(CVD). The four largest biological risk factors for CVD in men of color are hypertension, chronic kidney disease, obesity, and low levels of HDL (“good” cholesterol). In addition, men of color face barriers to accessing programming designed to reduce CVD risk related to race and identity construction, and further research is needed to understand how to support the participation of men of color in this programming. In response, the goal of this research project was to compile effective and pragmatic strategies for engaging and sustaining the participation of men of color in CVD risk reduction programming. Specifically, focus was directed towards understanding how constructs of gender and masculinity influence perception and utilization of public health programming. Findings suggest that Black men in the U.S. construct and enact their masculinities in ways that endorse traditional/hegemonic beliefs, and that this endorsement was at times associated with greater utilization and adherence to health routines and interventions, and at other times negatively associated. Both a literature review and analysis of qualitative interviews led to the conclusion that more research is necessary in this field to understand the complexities and intricacies of a misunderstood and under-researched problem. Gender and race necessarily combine to create health behaviors/outcomes but the nature of these effects are highly influenced by social, geographic, and cultural contexts. Programs seeking to capitalize on masculinity as a recruitment tool should carefully survey their target populations before implementing any strategy, as the deleterious effects of gender-based messaging can be significant.

**Simulating Hide and Seek with Convolutional Neural Networks and Boosting**

Yuki Zaninovich, 2018, Computer Science

Kyle Harrington, Computer Science

My research involves digitally simulating predator behavior in the wild using an image classification algorithm enhanced by machine learning. The algorithm is tasked to predict whether a octagonal-shaped "prey", intelligently camouflaged to its background, exists within a given image.

This is accomplished by training my algorithm with 2 powerful machine learning techniques: Convolutional Neural Networks (CNN) and Boosting. A single-layer CNN is trained to produce an output image indicating the predicted position of the prey. This image is then compared to a "classification image", which depicts where the prey actually resides, to produce an "error image" that highlights pixels the algorithm misclassified.

Now we incorporate Boosting, which attempts to create a strong and accurate classifier by combining multiple weak classifiers. The error image now becomes the new classification image, which effectively tasks the next CNN iteration to specialize solely on eliminating the inaccurate classifications of the previous CNN iteration. Though the accuracy of a single-layered CNN is limited, having each CNN iteration specialize in a particular subset of pixels led to a nearly perfect classification.

I also explore the ability of my algorithm to generalize better over different backgrounds. Instead of processing one image each time, I opted to train on multiple images of prey on different backgrounds in hopes of preventing my algorithm from overspecializing on just one type of background while being trained.

**Robots, Reliquaries, and Resurrection: Imagining the Medieval Body in Metal**

Drew Zeiba, 2016, Art History

Karen Overbey, Art History

Stories of automata can be found throughout medieval Europe, whether in wondrous depictions of abroad or manuscript illuminations from more close to home. Of particular interest are automata that depict human
figures or human heads. In a Euro-Christian context these metal humanoid figures have an obvious aesthetic partner: the body-part reliquary. Both these types had real presence and real performative potential. Reliquaries were both the human and the divine, a transmitter and the saint themselves. Automata locate themselves amidst the in-betweenness of life and death, human and non-human. Reliquaries and automata conceive of death and dismemberment in tandem thereby reconfiguring the status and blurring the boundaries of their opposites: life and wholeness. Similarly, medieval automata and reliquaries disclose not just the anxiety of death and decay, but also ways to get around it. Medieval automata and reliquaries are (post)human agents that react to and against their interlocutors and surroundings. Furthermore, these objects represent and disclose their own performativity in their very objectness. By investigating how material, likeness, and performance are similar and different between these two types I hope to uncover a medieval sense of bodily imagination in crafted objects. I also intend to explore the alignments and coincidences in secular and religious theories that center or contextualize these objects—positive or otherwise. Much of this exploration will rely on twelfth century texts and objects from Francophonic Europe, as well as later fourteenth century anti-scientific texts which locate automata among dark magic and foreign influence that troubled notions of freewill, futurity, and Euro-Christian hegemony. Body-part reliquaries and automata, especially speaking heads, share formal similarities and theoretical underpinnings how these objects instantiate their own theories of performance, likeness, and presence in the spaces between life and death.