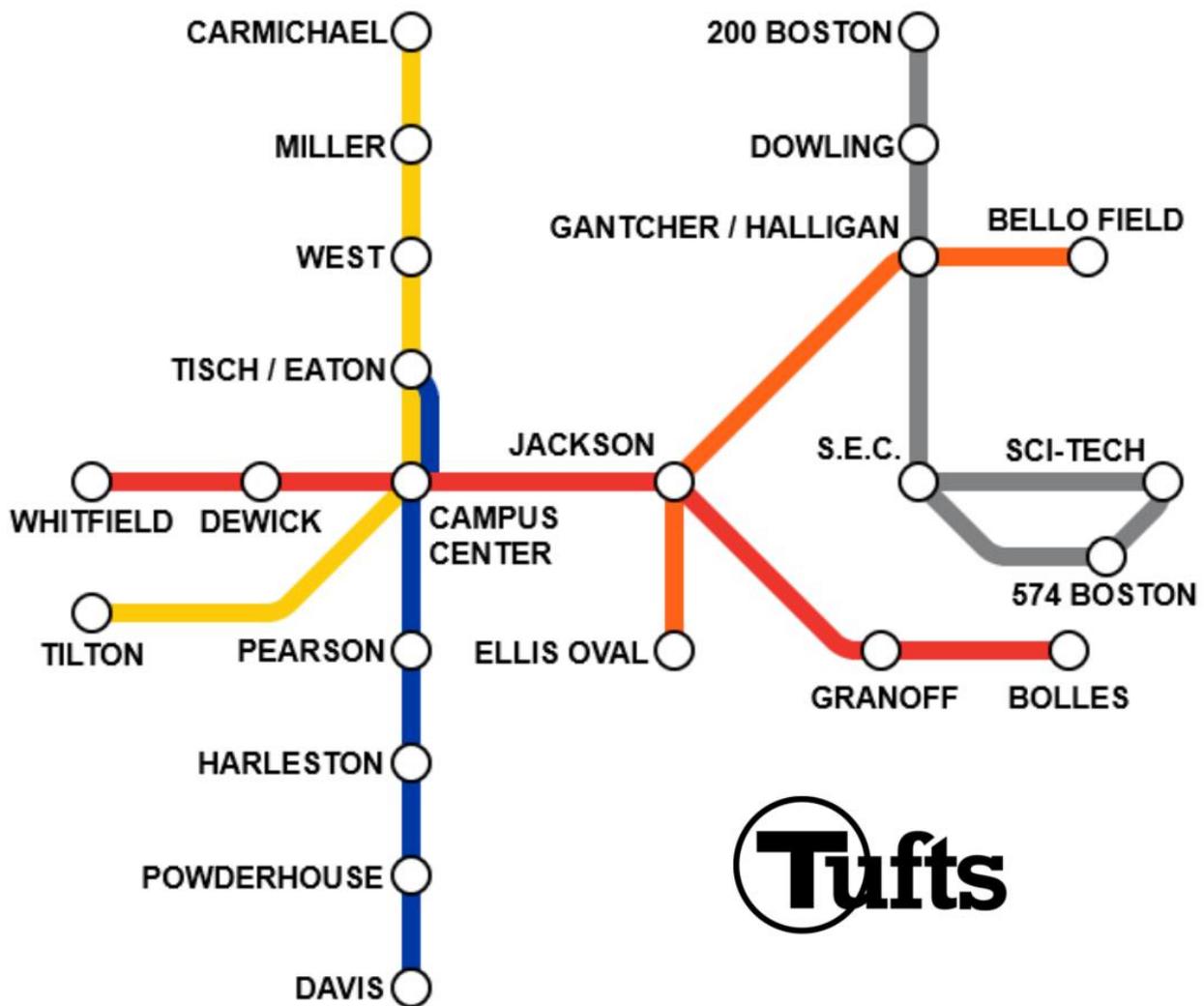# TUFTS UNDERGRADUATE RESEARCH and SCHOLARSHIP SYMPOSIUM

MAY 3, 2018

Welcome to the 20th 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.

The Symposium will open with a plenary address by Associate Professor Tim Atherton of the Physics and Astronomy department at 12:15 pm. Panel discussions consisting of oral presentations will be held in Aidekman and Granoff from 1:00 pm to 3:00 pm, and again from 4:30 pm to 6:30 pm. The poster session will be held at the Alumnae Lounge from 3:00 pm to 4:30 pm. This is followed by a reception and dinner at the Remis Sculpture Court at 6:30 pm.

For the past twenty years, this Symposium has been an unparalleled platform for active academic dialogue among scholars. Thought-provoking 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 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,

2018 Undergraduate Research and Scholarship Symposium Committee

Ani Hopkins, 2019, (No Major) with a focus in Cybercommunications
Schuyler Link, 2018, Biomedical Engineering
Adam Zoll, 2018, ACS-Certified Chemistry & Spanish

Staff Advisor: Dr. Anne Moore, Program Specialist, Scholar Development
Graduate Student Advisor: Emma Futhey, Ph.D Candidate, Department of Drama and Dance
Faculty Advisor: Dr. Harry Bernheim, Department of Biology

Schedule of Events

11:30 AM – 12:15 PM   Lunch and Registration
                             Alumnae Lounge

12:15PM – 12:45PM   Plenary talk by Associate Professor Tim Atherton, Physics and Astronomy
                             Alumnae Lounge

1:00PM – 3:00PM   Oral Session 1
                             Aidekman and Granoff

3:00PM – 4:30PM   Poster Session
                             Alumnae Lounge

4:30PM – 6:30PM   Oral Session 2
                             Aidekman and Granoff

6:30PM   Reception and Dinner
                             Remis Sculpture Court

Oral Presentations 1

Mathematical Models – Aidekman, Room 009

Marilyn Sun	Minimizing Bangs Generated by Autobahn for Haskell Programs Using GHC Profiling Feedback
Chengli Li	The Investigation of Data-Analytic Methodologies for Wealth Distributions
Christopher Keyes	Growth of Points on Hyperelliptic Curves
Daniel Meyer	Exploring the Role of Pfam Families in Protein Function

Science, Cognition, and Culture– Aidekman, Room 012

Daniel Kaltman	Mass Disruption and Preference of Cognitive Drug Stimuli of *Physarum*
Colin Trimmer	Noise-Induced Changes in Finch Song Revealed by Bone Conduction
Mattison Barickman	A Geochemical Evaluation of Cryptotephra from Montserrat, Lesser Antilles Arc
Diane Arnos	The Effect of Homelessness and Gender on Indicators of Severity and Comorbidity in Admissions to Substance Use Disorder Services
Megan Warshawsky	Implicit Ambivalent Racist Sexism: An Intersectional Approach to Racial and Gender Bias

Molecular Impacts – Aidekman, Room 013

Shant Mahrokhian	Identification of Host Immunological Pathways in the Resolution of *Babesia microti* Infection
Lauren Varanese	Targeting the MCL-1-BL3 Domain Protein-Protein Interaction with Small, Cyclic Peptides
Jane Blackmer	The Effect of DNA Double-Strand Break Repair on Trinucleotide Repeat Expansions in Drosophila melanogaster
Katherine Campbell	Gpr126 Contributes to Terminal Schwann Cell Function after Nerve Injury
Thien Khuu	Ambient Energy Matrix Isolation Spectroscopy

Justice and Politics – Granoff, Room 155

Olivia Schultes	Borehole Functionality by Management and Spatial Characteristics in the Eastern Region, Ghana
Ani Soultanian	Disparities of Justice Across Adversarial Lines in New England
Julie Murray	Legacies of the Anglo-Hashemite Relationship in Jordan
Sara Banbury	Use of Water and Sanitation Infrastructure to Predict Schistosomiasis, Malaria, and Diarrheal Disease in the 216 Ghanaian Districts

Framing and Attitudes – Granoff, Room 271

Anna Kimura	Developing and Teaching an Anti-Bias Curriculum in a K-5 School: Leadership, Teachers', and Young Children's Experiences
Liren Fu	Reframing for Reasoning: Eliciting and Evaluating Student Reasoning in Biology Laboratory Reports
Sylvie Grenier	Young Adult Attitudes about Global Climate Change: Studying Youth Commitment to Resolving Societal Problems
Lauren Do	How Do Perceptions of Quality of Life Influence Attitudes Towards Government?
Allison Kannam	The Role of Summer Meal Programs for New York City Parents

Oral Presentations 2

People in Spaces – Aidekman, Room 009

Emma Kahn	Frictional Reimaginations of the Civic Commons
Shaan Merchant	Madam Senator: Political Visibility and Identity-Based Attacks Online
Fatima Ajose	Mama We Made It? : Mental Health of Black Undergraduates at Predominantly White Institutions in Boston
Max Farber	Navigating a Hyperfeminized Profession: The Experience of Masculine Midwives and Their Clients
Sophie Pearlman	"Not the American We Dreamed Of:" Identity, Belonging, and Citizenship of Latinx Immigrants in Donald Trump's America

Narratives – Aidekman, Room 012

Pranav Menon	"Fall and Fallout": The Narrative Language of Paradise Lost
Sabrina Manero	Fear, Unsettled; Poe, Wilde, and Gothic Anxiety
Carissa Fleury	The Will To Remember: A Journey Through a Black Family's Life in 20th Century Nashville, TN
Anna Ellis	(RE)COVERED IN FRUIT: Unmasking Eating Disorder Recovery Counternarratives in the Internet's Vegan Community

Music and Meaning – Granoff, Room 155

Sonia Bourdaghs	Musical Involvement and Negative Affect among Individuals with Parkinson's Disease
Eleanor Rimmerman	A New Music-Medicine: Participatory Affective Musical Experience in Clinical Settings
Olivia Carye-Hallstein	Auswerkung

Materials and Models – Granoff, Room 271

Sydney Holway	Clogging in Microfluidic Devices
Thomas Keller	An Investigation into Methods for Electrospinning Poly(ether ether ketone)
Isabelle Anderson	Mechanical Properties of Recycled 3D Printed Plastic
Craig Drennan	Improving Estimations of Optical Properties in Coastal Ocean Color Modelling

Poster Session

Presenter	Poster Title
Gladys Argueta Xiloj	Evaluation and Quantification of Proteins Present During Fetal Development for Use in Regenerative Engineering Approaches for Biomaterials Design
Sidney Beecy	Effects of Enrichment on Long Term Captivity in European Starlings (*Sturnus Vulgaris*)
Alexander Berk and Javier Rincon	Development of in-vitro Contusion and Stroke Models Using Primary Mouse Neurons Co-Cultured with Astrocytes and Microglia
Greg Berumen	New Strategies for the Discovery of Highly Specific Enzymes
Giles Bullen	New Platforms, New Opportunities: The Problems and Promise of Civic Board Games
Olivia Carye-Hallstein	Auswerkung
Cassandra Collins	Examining Peak Alpha Frequency as a Trait Metric for Individual Variability
Marisol Consuegra Prado	Examining Relationships Among Nonsuicidal Self-Injury, Childhood Emotional Abuse, Perceived Criticism, and Emotion Dysregulation
Marisol Consuegra Prado	Dyadic Association between Perceived Criticism and Depression in People with Parkinson's Disease and Their Care Partners
Annalisa DeBari	Degradation of Lithium Ion Batteries
Michelle Delk	Post-treatment Disparities in Arrests for Individuals with an Alcohol Use Disorders
Libby DesRuisseaux	P2Y6R Involvement in Glymphatic Pathway Clearance of Amyloid Beta: Molecular and Behavioral Implications for Alzheimer's Disease
Lisa Fantini	Thermophotovoltaic Cell Characterization through Photoluminescence and Quantum Efficiency Measurements
Zachary Finn	Salary Negotiations and the Minority Wage Gap
Charles Frankel, Catherine Gao, Robert Hendler, Jonathan Rooney	R Prime Robot
Mateo Galeano Londoño	Chlorine Taste and Odor Detection and Rejection Thresholds for Beneficiaries in Refugee/ IDP Camps
Hernán Gallegos	An Interview Study of Faculty, Course Assistant, and Student Insight within Teaching and Learning Assistant Programs for Undergraduate Engineering Courses
Hannah Harris	Investigating the Role of HCN4 during Embryogenesis
Julia Hofer	Identification and Characterization of Novel Genes Involved in Glutamatergic Synaptic Signaling and Behavior in *Caenorhabditis elegans*
Nairi Krafian	The Impact of Animal-Assisted Interventions on Armenian Youth
Leyla Kursat	Emergence of Systematic Structure in CTSL

Schuyler Link	Formulating Silk Patches for Skeletal Muscle Repair
Arielle Mann	The Effect of Alkyl Chain Length on Mechanochromic Dialkylester Substituted Phynelene Ethynylene Oligomers
Jacob Marsh	The Rate of Modern Sea Level Rise in Boston
Angelo Massaro	Concentrating Platelets: From Bench Success to Therapeutic Relevance
Ruth Meadow-MacLeod	Finite Presentability of Groups
Arya Mekkat	Effects of Mutations in Osteogenesis Imperfecta on Structural Stability of Collagen
Trang Ngo	Infrared Spectra and the Coverage of Molecules on Surfaces of Solid Catalysts
Neeki Parsa	Taking a Queer Pulse: The Impact of Medical Structure on Healthcare for Non-Binary Patients in Boston
Harry Paul	A 3D Bioengineered Model of Intestinal Immunity to Modulate Pathogen Transcytosis
Rachel Pollard	*In vitro* Characterization of TRPA1-Mediated Acute Pain and Wound Healing in a Silk-Based Cornea Model
Marina Rakhilin	The Impact of a Short-Term Mindfulness Induction on Experiential Avoidance
Adam Rayfield	Modeling Oxygen Tensions, Biomass Generation, and Cellular Phenotypes in 3D Silk Sponges Cultured Under Perfusion
Eli Rosmarin	The Reassignment Problem
Aliyah Sanders	Associations between Cognitive Impairment and Symptom Severity in Schizophrenia and Schizoaffective Disorder using CANTAB
Sara Schiff	Children's Understanding of the External Causes of Emotion
Henry Seidel	Synthesis, Characterization, and Reactivity Studies of a Cobalt-Centered Aminopyridine Macrocyclic Catalyst
Edith Statham	Cytokines and How They Induce Tim3 and PD1 in Melanoma Cells
Emma Steiner	History and Memory of Chilean Unions
Andrew Takasugi	Modeling Damage Scenarios: An Analysis of How Damage Function Specification Affects the Optimal Carbon Price
McKinzey Torrance	Comparing Objective and Subjective Measures of Inattention that Predict Forgetting
Zachary Wallace	Understanding How Protein-Protein Interaction Distance Metrics Can Be Used in Disease-Gene Prioritization
Megan Warshawsky	Implicit Ambivalent Racist Sexism: An Intersectional Approach to Racial and Gender Bias
Josephine Watson	Battle of the Regenerative Agriculture vs. Climate Smart Agriculture Paradigms in the Age of Climate-Induced Agricultural Reform
Aaron Watts	Biological Denitrification in Porous Media
Seblewongel Yigletu	Lessons Learned from a Community-Based Participatory Research Collaboration between the Medford Family Network and Tufts University

Yoojin Yoon	Partnering with North Suffolk Mental Health to Increase Access to Cancer Prevention, Early Detection, and Treatment
Adam Zoll	Synthesis and Characterization of Bioinspired Manganese(II) Aminopyridine Catalysts for Environmentally-Friendly Olefin Epoxidation

Mama We Made It?: Mental Health of Black Undergraduates at Predominantly White Institutions in Boston

Fatima M. Ajose, 2018, Community Health & Africana Studies

Dr. Shalini Tendulkar, Community Health

My research involves the mental health of Black-identifying undergraduate college students that attend predominantly white colleges or universities in the Boston area. It aims to understand the impact of being at a predominantly white college or university on the mental health status of Black undergraduate college students. As well as, how factors such as race, culture, sexuality and gender influence their mental health status. Along with understanding what factors such as students groups, support mental health status among Black undergraduate college students.

Mechanical Properties of Recycled 3D Printed Plastic

Isabelle C. Anderson, 2021, Mechanical Engineering

Independent research

With the 26% annual growth rate of additive manufacturing, especially in the area of 3D polymer printing, the amount of waste is increasing at a rapid rate. Limited research in the area of recycling has been produced, yet there are several recycling machines being developed for home use. Despite this work there has been no published mechanical data on components produced with filament recycled from 3D printed parts. There is very limited data on mechanical properties of any 3D printed materials. My research program compared the properties of parts 3D printed with virgin polylactic acid(PLA) to those printed with recycled PLA. Using commercially available PLA and an entry level 3D printer, tensile and shear specimens were produced and then tested for tensile yield strength, modulus of elasticity, shear yield strength, and hardness. The specimens were then ground up and re-extruded into filament, and a second set of specimens were produced and tested using this recycled PLA filament. Mechanical testing showed that 3D printing with recycled PLA is a viable option. With the recycled filament, tensile strength decreased 10.9%, shear strength increased 6.8%, and hardness decreased 2.4%. The tensile modulus of elasticity was statistically unchanged. Although the average mechanical properties before and after recycling were similar, there was more variability in the results of the recycled filament. Additionally, when printing with the recycled filament there was some nozzle clogging, while none occurred with the virgin filament. Overall, the mechanical properties of specimens 3D printed from recycled PLA filament were similar to virgin properties, encouraging further development in the area of recycling 3D printed filament. This research was published as: Mechanical Properties of Specimens 3D

Evaluation and Quantification of Proteins Present During Fetal Development for Use in Regenerative Engineering Approaches for Biomaterials Design

Gladys A. Argueta Xiloj, 2018, Biomedical Engineering

Lauren Black, Whitney Stoppel, Biomedical Engineering

Fetal development is a time when immature cells grow and proliferate in tissues such as the heart. The cells' growth is greatly affected by the extracellular matrix(ECM), thus, understanding how the local microenvironment plays a role in a cell's ability to proliferate is key to enhancing the regenerative potential of many organs in adults. To understand this, we aim to quantify and evaluate protein expression and tissue composition change during development using methods like LC-MS, immunohistochemistry and western blot analysis of porcine fetal tissues. Results will guide the use of fetal ECM in materials for regenerative medicine.

The Effect of Homelessness and Gender on Indicators of Severity and Comorbidity in Admissions to Substance Use Disorder Services

Diane M. Arnos, 2018, Biology, Community Health

Andrea Acevedo, Community Health

Background: Substance use disorders and homelessness are two closely related issues with far reaching health impacts. This study examined whether homelessness is associated with indicators of severity of SUDs and psychiatric comorbidity. This study also examined if gender is associated with these same variables within homeless admissions.

Methods: This study used national administrative data on admissions to publicly funded substance use services. The sample consisted of 1,256,770 adult admissions to services. The second analysis used a sample of 225,844 homeless adult admissions. Logistic regression models were used to examine the association between homelessness and the dependent variables and the association between gender and the same dependent variables.

Results: After controlling for race and ethnicity, age, gender, education level, employment status, service setting, and state, homelessness is significantly associated with increased odds of cocaine and methamphetamine use, higher frequency of use, younger age of first use, use of more substances, injection drug use, and co-occurring psychiatric problem. After controlling for

race and ethnicity, education level, service setting, and state, female gender is highly associated with higher odds of all substances besides alcohol and co-occurring psychiatric problems.

Conclusions: Homeless individuals enter substance use services with indications of more severe substance use disorders, different patterns of use, and more psychiatric comorbidity. Homeless women have different patterns of substance use and much higher likelihood of psychiatric comorbidity than homeless men. Future research should focus on the specific treatment needs of homeless individuals, and homeless women in particular.

Use of Water and Sanitation Infrastructure to Predict Schistosomiasis, Malaria, and Diarrheal Disease in the 216 Ghanaian Districts

Sara I. Banbury, 2018, Community Health

Karen Kosinski, Community Health

Previous research has demonstrated that the burdens of diarrheal disease, schistosomiasis, and malaria have strong ties to the quality and quantity of water and sanitation access in a population; control measures often center around improving access and preventing contamination of a water supply. Studies on these topics often rely on outdated or poor quality data. We used 2010 national census data for all 216 districts in Ghana published by Ghana Statistical Service that included 23 demographic variables and information about water and sanitation infrastructure (102 variables), as well as a Ghana Health Service dataset composed of 60 months (01/2012-12/2016) of district-level disease counts (20,718 observations) to assess risk factors and identify relationships between WASH access indicators and disease burden. We found substantial geographic heterogeneity in uses of water and sanitation infrastructure, as expected. Schistosomiasis demonstrated some variability longitudinally and spatially, while diarrheal disease counts were mainly homogenous. We truncated the malaria data after nine months due to an abrupt halt in reporting with a gap of 14 months with no observations, which prevents comparisons to schistosomiasis or diarrhea. The disease counts contained no confirmed zeroes; it was unclear if blank cells represented missingness or true zeros. Relationships between water and sanitation infrastructure use and disease burden are still being explored. The lack of current and high quality data prevents conclusions about key drivers of schistosomiasis, malaria, and diarrheal disease. This thesis will enable stakeholders to better understand how water and sanitation challenges relate to disease burden and will further underline the need for better data reporting practices.

A Geochemical Evaluation of Cryptotephra from Montserrat, Lesser Antilles Arc

Mattison H. Barickman, 2018, Geological Sciences

Molly C. McCanta, University of Tennessee, Knoxville, Department of Earth & Planetary Sciences

In volcanic eruptions, magmatic or phreatomagmatic fragmentation transforms the erupting magma into a gas-particle/droplet mixture that is then injected into the atmosphere as an ash plume. The material from this ash plume is then deposited on land or in the ocean as a tephra layer, an unconsolidated, fragmented material, or cryptotephra, which is a tephra layer that is invisible to the naked eye. Tephra has long been used in geochemical studies of volcanic systems to assess how the magma chambers evolve in terms of their composition and volatile content. It is particularly useful as a chronostratigraphic marker which can provide precise age dates for both ice and oceanic cores. This project explores two newly documented cryptotephra deposits from core U1396-1H-4W collected on IODP expedition 340 to the Caribbean Sea, near Montserrat. The overall particle content and composition is documented through point counting and textural analysis via scanning electron microscopy (SEM), which indicates that white glass, mineral fragments, and vesicular pumice fragments are the main constituents of these cryptotephra deposits. A geochemical evaluation of glass particles in both deposits indicates that samples range in composition from rhyolitic to dacitic. The variation in composition of glass particles in core segment 11-15cm can be attributed to one of two processes: mixing of a more silicic and a more mafic magma in the chamber which feeds the various volcanic complexes on Montserrat, or a relatively fast ascent rate of magma through the crustal column which leads to relatively less degassing until the magma reaches the subaerial environment. The low variance in composition of glass particles in core segment 41-45cm suggests that the magma either ascended through the conduit at a slower rate and degassed as it rose, or that the magma chamber fractionated significantly before the eruption.

Effects of Enrichment on Long Term Captivity in European Starlings (*Sturnus vulgaris*)

Sidney J. Beecy, 2018, Biology

L. Michael Romero, Biology

Undomesticated animals are prone to developing abnormal behaviors in captivity, such as stereotypies, but the physiological stress profiles of these animals can vary widely. This study examines the effects of social and environmental enrichment on the stress levels of eight starlings in long-term captivity. Originally, the starlings were housed in individual bird cages that were attached to experimental apparatuses. Enrichment was provided using an aviary approximately 9x larger in volume than a home-cage, containing perches, toys, food, and water.

Two groups of four starlings spent three hours in the aviary twice a week. Blood was sampled at regular intervals to determine CORT profiles using a three-part measurement (baseline, stress-induced, and negative feedback) related to physiological stress. Additionally, the birds were video recorded weekly in their home-cages and in the aviary in order to examine behavioral effects. We found that the enrichment protocol significantly changed the behavior of the starlings, including reduction of stress-related behaviors during some enrichment phases. However, enrichment did not significantly affect CORT profiles, highlighting the dissonance between behavioral and physiological stress measurements.

Development of *in-vitro* Contusion and Stroke Models Using Primary Mouse Neurons Co-Cultured with Astrocytes and Microglia

Alexander Berk and Javier Rincon, 2018, Biomedical Engineering

David Kaplan and Volha Liaudanskaya, Biomedical Engineering

Within the United States, traumatic brain injuries (TBIs) results in over 52,000 deaths annually. Among severe cases of TBI, contusion with related hemorrhage and stroke result in the development of serious mental and motor impairments. A lack of viable treatments and understanding of the molecular mechanisms underlying TBIs make developing relevant injury models of critical importance. We developed in vitro models to study contusion and stroke injuries. The models are composed of silk sponges seeded with cortical or striatal neurons (for contusion and stroke models, respectively) embedded in a collagen gel. We optimized sponge porosity to maximize cell viability, activity, and neuronal network formation. Sponges with 300um pores showed optimal results for striatal neurons, while sponges consisting of stratified layers with 100um to 700um pores was ideal for cortical neurons.

Several methods were explored to induce a stroke injury, including the injection of whole blood, plasma, and red blood cell lysate. By quantifying the death rate of striatal neurons, associated metabolic activity, cytotoxicity, and type of cell death, we determined that whole blood or plasma is ideal for inducing a stroke injury. For the contusion model, a decline in metabolic activity and increased death rate were observed 24 hours post-injury, similar to in vivo results. Data regarding cortical and glial cell activity in mono- and co-cultures post-injury indicate an increase in inflammatory cytokines including IL-1B and IL-6 due to inflicted trauma. As we move forward with the stroke model, we will continue to explore mechanisms of cell death as well as glial cell contributions. For the contusion model, further gene and protein expression analysis will be performed in the different sponge layers, along with an analysis of the molecular pathways associated with cell death. For both models we will investigate and screen the effectiveness and potential of various drug treatments.

New Strategies for the Discovery of Highly Specific Enzymes

Greg Berumen, 2019, Chemical Engineering

James Van Deventer, Chemical and Biological Engineering

Within the tumor environment, enzymes play a key role in the proliferation of cancer cells and the communication between these cells and normal cells. Currently, there are only a limited set of tools available for disrupting these processes. In this work, we propose new strategies for discovering highly specific inhibitors capable of disrupting these processes. We aim to build off the two major classes of therapeutics that have been pursued thus far: biologics (such as insulin) and small molecule chemicals (such as Advil). Our strategy is to combine the best aspects of these two classes of therapeutics to discover highly specific enzyme inhibitors. We will do this through two objectives: first, we will work on encoding novel chemical functionality into proteins through genetic code manipulations in yeast. Then, we will explore ways to combine these proteins with reactive small molecules. The result of this will be a "protein-small molecule hybrid," an inhibitor with properties that cannot be accessed by either proteins or small molecules alone. We anticipate that through this platform, we will be able to identify robust and specific enzyme inhibitors to target enzymes that play crucial roles in tumor growth. Successes in this work will have broad applications in understanding cancer biology, and could also lead to new therapeutic targeting strategies.

The Effect of DNA Double-Strand Break Repair on Trinucleotide Repeat Expansions in Drosophila melanogaster

Jane E. Blackmer, 2018, Biology

Mitch McVey, Biology

Trinucleotide repeats are unstable and dynamic microsatellites in the genome, able to contract and expand their number of repeats. While trinucleotide repeats are present in all humans to some extent, the number of repeats is highly variable. Repeat number can be altered during cellular processes such as replication, transcription, and DNA repair. Trinucleotide repeats cause a number of neurodegenerative diseases in humans once expanded past a certain threshold length, and perturb cellular metabolism on the DNA, RNA, and protein levels. These diseases are highly heritable and exhibit genetic anticipation due to potentially large-scale expansions occurring in the germ line. When the DNA is single-stranded (during replication, transcription, or DNA repair), expansions can occur. One cause of pathology comes from abnormal secondary structures, such as hairpins, that the repeats form in single-stranded DNA, hindering DNA damage repair machinery. One particularly important form of DNA damage is the double-strand break. In the presence of CAG repeats, there is an increased propensity for aberrant double-strand break repair. There are three main types of DNA repair:

non-homologous end joining, microhomology-mediated end joining, and homologous recombination. Recombination has been shown to cause repeat expansions in yeast when the break occurs in the vicinity of the repeats. This project utilizes a new assay to study repeat expansion after DNA double-strand break repair via recombination in Drosophila. This assay measures different repair outcomes and looks at the number of repeats present after repair via recombination. Preliminary results indicate that the majority of repair outcomes from the assay are non-homologous end joining, as expected, but there are some breaks repairing via homologous recombination. These recombination repair events are being further characterized to determine if repeat expansions have occurred during repair. These results will help elucidate the underlying molecular mechanisms for trinucleotide repeat expansions.

Musical Involvement and Negative Affect among Individuals with Parkinson's Disease

Sonia W. Bourdaghs, 2018, Music & Cognitive and Brain Sciences

Sarah Gunnery, PhD, Department of Occupational Therapy

Linda Tickle-Degnen, PhD, OT, FAOTA, Department of Occupational Therapy

Music has been shown to reduce depressive mood among several populations with chronic health conditions. This study looked at the relationship between active versus passive musical involvement and mood among individuals with Parkinson's disease. As in previous research, we defined active involvement as creation of musical environment, and passive involvement as reception of music. This study explored the association between different types of musical involvement and negative affect -- including depressed, apathetic, and anxious mood -- among individuals with Parkinson's disease.

Data came from the baseline time point of the longitudinal Social Self-Management of Parkinson's Disease database (PI Tickle-Degnen). Measures included the Activity Card Sort, which measured three active and two passive forms of musical involvement. Participants indicated whether each activity had never been done, had been given up, or was currently done less than, the same as, or more than six months ago. Participants received composite active, passive, and total musical involvement scores based on their responses. The composite negative affect scores were based on answers to the Geriatric Depression Scale, the Social Isolation Domain of the Nottingham Health Profile, and items from the SF-12 v2 Health Survey, the Parkinson's Disease Questionnaire-39, and the Movement Disorder Society's Unified Parkinson's Disease Rating Scale.

We found a significant negative correlation between total musical involvement and negative affect (r(88) = -.34, p = .001), and between active musical involvement and negative affect (r(71) = -.28, p = .02). There was no relationship between passive musical involvement and negative affect (r(88) = -.11, p = .30). These results suggest that musical involvement, and particularly active involvement in music, is related to lower levels of aversive mood among individuals with Parkinson's disease. With high comorbidity rates between Parkinson's disease and depression, safe, economical, interventions like musical involvement show great promise.

New Platforms, New Opportunities: The Problems and Promise of Civic Board Games

Giles Bullen, 2018, English & Film and Media Studies

Julie Dobrow, Eliot-Pearson Department of Child Study and Human Development

Crowdfunding, in which a creator places their project on line and encourages fans and early adopters to contribute money towards its creation, has allowed for an increase in board game production and the audience's role in that production. This has opened up considerable opportunities for a wide array of games topic and themes to be developed, including games that focus on education. Part of the intent of this research is to address questions about educational games, specifically those that seek to present civic topics and themes to young players, and whether a physical format might help improve the educational objectives of the game. This shall be accomplished through an examination of digital and tabletop games designed for education, as well a review of literature on fan studies, crowdfunding and crowdsourcing, and literature on both media's narrative and emotional effect, and board games and crowdfunding efforts for them. The research conducted includes a literature review of work done on educational games, civic education, and crowdfunding in general. The study also includes an analysis of a variety of games, both those created for civic education and those meant largely as a form of entertainment, exploring how they succeed or fail at embodying a series of principals associated with effective civic education game design.

Gpr126 Contributes to Terminal Schwann Cell Function after Nerve Injury

Katherine Campbell, 2018, Biology & Spanish

Alison Snyder-Warwick, Washington University School of Medicine

Schwann cells are the main glial cells of the peripheral nervous system (PNS). Terminal Schwann cells (tSCs) reside at the neuromuscular junction (NMJ) and assist in reinnervation. The G-protein coupled receptor family (GPCR) is a diverse family of transmembrane receptors implicated in nervous system, heart, and ear development. One such GPCR is the orphan

receptor Gpr126 which is characterized by an extremely long N-terminus. Gpr126 is expressed in Schwann cells to organize Schwann cell differentiation, radial sorting, and perineurial organization. It is known that Gpr126 is essential for myelinating Schwann cell development and function, but the role Gpr126 plays in terminal Schwann cell function after injury is not well understood. Using a mouse model with a conditional knockout of Gpr126, the accessory nerve between the sternomastoid and cleidomastoid muscle was injured by cut or crush. Analysis of the injured and uninjured side was performed by immunofluorescent staining followed by imaging with a compound microscope, as well as analysis of RNA expression. Protein and mRNA analyses show decreased and delayed innervation, decreased normal phenotype of acetylcholine receptors, and less macrophage recruitment after injury in cGpr126 mice as compared to wild type and littermate control mice. This suggests that Gpr126 is required for tSC contributions to NMJ reinnervation after peripheral nerve injury, which may have implications regarding the development, injury and repair of the NMJ which can be translated into improved recovery guidelines following nerve injury.

Auswerkung

Olivia A. Carye-Hallstein, 2018, Fine Art

Eulogio Guzman, Visual and Critical Studies

Consumption plagues modern life by creating greater excess than the planet can handle. Artists have contributed to this awareness through work describing this phenomenon. From the celebration of the commodity in Stuart Davis' early work to Thomas Hirschhorn overflowing a gallery with piles of cans, artists create situations, which confront the viewer with the consequences of an ideology of consumption. But who and how are these works influencing the creation of a solution? Simultaneously describing and showing how consumption has been thematised within the art world, performance is used in this presentation to fully immerse the viewer in an overwhelming feeling. Based in independent academic and creative research, this performance both analyses and questions the role of art in political mobilization. The use of music, directives and analysis demonstrate how artists in the last century reflect the problem of helplessness in the face of a world full of products. Traditionally, the use of intervention in art is to provoke action in the face of passivity. By approaching the theme of consumption in a creative fashion, the audience is confronted with the struggle of art for political relevance.

Examining Peak Alpha Frequency as a Trait Metric for Individual Variability

Cassandra C. Collins, 2018, Cognitive and Brain Science

Elizabeth Race, Psychology

Attentional fluctuations during sustained attention tasks have been shown to impair memory encoding for both task-relevant and irrelevant stimuli. However, researchers have yet to take a step back and identify a reliable trait marker that predicts the attentional fluctuations that negatively impact the encoding of incoming information. While alpha power has already been implicated in modulating momentary fluctuations in attention, the current study uses EEG imaging to investigate whether individual variability in the peak of the alpha band as measured by Individual Alpha Frequency (IAF) can serve as such a trait marker that predicts not only inattention but later forgetting as well. EEG was recorded during five-minutes of resting state measurement and throughout an incidental face-encoding task. IAF was measured at rest and during a cognitive task and correlated with subjective and objective behavioral measures of participant's attention and memory performance. In support of past literature, results revealed that IAF was stable over time on a between-subjects. Additionally, participants' resting state and task IAF values were both predictive of inattention as measured by the number of omitted responses on the memory task; task IAF alone predicted subjective attention as measured by probed mind-wandering. Neither rest nor task IAF was correlated with recognition memory. Taken together, these results confirm the stability of IAF over time and suggest that IAF may play a general role in preparing a subject to attend to incoming information but not a specific role in memory processes.

Examining Relationships Among Nonsuicidal Self-Injury, Childhood Emotional Abuse, Perceived Criticism, and Emotion Dysregulation

Marisol Consuegra Prado, 2018, General Psychology

Kathryn R. Fox, Harvard University - Clinical Research Laboratory

Nonsuicidal self-injury (NSSI) is a strong predictor of future suicide attempts. Childhood emotional abuse is related to engagement in NSSI and emotion dysregulation has previously showed to mediate that relationship. However, emotion dysregulation is a multifaceted construct and it remains unclear what aspects of it explain this relationship. Perceived criticism (PC) has been found to be associated with both childhood emotional abuse and emotion dysregulation. However, the relationship between NSSI and PC is less clear. We explored associations among NSSI frequency (lifetime and past year), childhood emotional abuse, three facets of emotion dysregulation (i.e., emotional reactivity, reappraisal, suppression) and PC (close parent and close other). Ninety-nine participants (Mage= 24.78, SDage=6.09; 76.8% Female) were recruited online. Results indicated a strong positive association between lifetime

NSSI frequency and childhood emotional abuse. This association was not present for past year NSSI frequency. The three facets of emotion dysregulation were not associated with NSSI frequency or childhood emotional abuse. Emotional reactivity was negatively associated with reappraisal. PC from a close parent was positively associated with PC from a close other. These were not associated with other variables. The association between lifetime, but not past year, NSSI frequency and childhood emotional abuse brings to focus the importance of time. Future studies are needed to evaluate whether that association naturally changes over time explaining the conflicting findings among studies using different measures of NSSI frequency (past week, month, year, lifetime). Unique associations with each other and variables of interest highlight that different facets of emotion dysregulation should be considered as unique constructs. Our findings show that either PC from a close parent or a close other could be used in studies. The lack of association between PC and the other variables suggests that PC may not be relevant to NSSI research in young adults.

Dyadic Association Between Perceived Criticism and Depression in People with Parkinson's disease and their Care Partners

Marisol Consuegra Prado, 2018, General Psychology

Linda Tickle-Degnen, Occupational Therapy

Parkinson's disease (PD) is a neurodegenerative movement disorder that causes motor and neuropsychiatric symptoms. Depression in people with PD (PwPD) is often associated with their care partners' (CP) depression. Perceived criticism, criticism that someone perceives from another individual, is also associated with depression, but little is known about the link between depression and the perception of criticism in PwPD and their CPs. Cross-sectional data were analyzed from the year one time point of the developing database of the three-year longitudinal study Emergence of Parkinson's Disease (SocM-PD). 50 dyads (PD: Mage = 65.64, SDage = 7.10, 34 males; CP: Mage = 64.83, SDage = 7.78, 14 males) independently filled out the Geriatric Depression Scale-15 and the Perceived Criticism Measure as part of the larger SocM-PD protocol. The Actor-Partner Interdependence Model (APIM) was used to measure the association between perceived criticism and depression in the partners taking into account non-independence in the dyad. There was no significant dyadic association between PwPD's and CP's perception of their partner being critical of them and depression. However, for CPs, being critical of their partner was associated with their own depression, $t(49) = 3.54$, $p = .001$, and with PwPD's depression, $t(49) = 2.48$, $p = .02$. These results suggest that CPs who believe they are more critical of their partner with PD experience more depression and that the partners with PD experience more depression as well. Future research will examine the relationship between perceived criticism and depression longitudinally to replicate these findings and determine the direction of causality.

Degradation of Lithium Ion Batteries

Annalisa DeBari, 2018, Mechanical Engineering

Iryna Zenyuk, Mechanical Engineering

Lithium Ion Batteries are a promising form of alternative energy storage because they have a high energy density and are rechargeable. However, during the cycling process, lithium microstructures form at the interface of the separator and electrolyte. These microstructures deform the inner components of the battery and can lead to battery fires. It is of critical importance for the battery community to better understand the formation of these structures. This project focuses on using x-ray tomography to collect images of the degradation of lithium ion batteries in operando experiments. A sample holder was designed for the operando x-ray tomography experiments, and coin cells were tested for comparison.

Post-Treatment Disparities in Arrests for Individuals with an Alcohol Use Disorders

Michelle Delk, 2020, Community Health

Andrea Acevedo, Community Health

Research Objective: Due to the link between alcohol use disorders (AUD) and involvement with the criminal justice system, arrest after treatment is an important outcome measure for treatment of people who report AUD disorders. The objectives of this study were to examine whether racial/ethnic disparities exist in post-treatment arrest and whether community level factors are associated with this outcome

Study Design: This study used administrative data on clients receiving publicly funded treatment services in Washington State, linked with criminal justice data. Community level data were obtained from the U.S. Census based on the census tract of the client's residence. Multilevel parametric survival models were employed with outcomes measuring time to any arrest.

Population Studied: The analytic sample was made up of adult clients receiving publicly funded outpatient treatment for AUD disorders in specialty settings in 2012 in Washington State. Most clients were White (64.5%), while American Indians made up 15.3%, Latinos 11.6%, and Black clients made up 8.7% of the sample.

Principal Findings: Compared with white clients, Black and Latino clients were found to be more likely to have any arrest in the year after treatment (HR=1.447; 95% CI=1.262, 1.659, and HR=1.184; 95% CI=1.038, 1.352 respectively). Additionally, clients living in communities with a

higher proportion of black residents were more likely to experience any arrest (HR=1.230; 95 %CI= 1.116, 1.354).

Conclusion: These findings suggest that, while outside/community-level factors contribute to the likelihood of arrests, other factors that are unaccounted for in our analyses may contribute to disparities in arrests. Treatment and policymakers should monitor these disparities and address them by intervening at the individual or community level.

P2Y6R Involvement in Glymphatic Pathway Clearance of Amyloid Beta: Molecular and Behavioral Implications for Alzheimer's Disease

Libby A. DesRuisseaux, 2018, Cognitive and Brain Sciences

Philip Haydon, Neuroscience

Alzheimer's Disease (AD), which is characterized by a progressive impairment in episodic memory as well as other behavioral and cognitive functions, is the most common cause of dementia, affecting about 5.5 million people in the United States alone in 2017. It is thought that AD is the result of the accumulation of amyloid beta, a neurotoxic protein, in the brain resulting from impaired clearance and homeostatic mechanisms. Dong et al. (in preparation) have identified a prodrug, GC021109, that has been shown to reverse the pathological accumulation of amyloid beta in the brain and the corresponding decrease of amyloid beta in the cerebrospinal fluid that is characteristic of AD in both preclinical mouse trials and human phase 1 clinical trials. GC021109 is an activator of the P2Y6 receptor, which is found in both glia and smooth muscles cells in cerebral vasculature. The relationship between P2Y6 receptors and amyloid beta clearance is not yet known. The goal of the current project was to elucidate the connection between P2Y6R activity and the glymphatic pathway, a cerebral waste clearance pathway, to determine whether P2Y6R is modulating amyloid clearance via this pathway. Fluorescent tracers were injected into the brain or CSF of mice, and the tracers' circulation throughout the glymphatic pathway was compared with and without GC021109 treatment to determine if treatment yielded increased glymphatic pathway circulation of these tracers. Behavioral assessments were also conducted on mouse models of AD to determine the effects of GC021109 on behavioral and cognitive symptoms of AD.

How Do Perceptions of Quality of Life Influence Attitudes Towards Government?

Lauren A. Do, 2019, Quantitative Economics & Philosophy

Margaret McMillan, Economics

Achieving citizen compliance, understanding and addressing the most pressing concerns is key to the success of governments. Our research explores how satisfaction with the economy, education, healthcare and safety affect overall satisfaction with the government in Morocco. Although it is easy to measure success in these areas through empirical and objective measures (i.e. spending or human resources allocated), understanding how the public perceives them is just as important for gauging success. Satisfied citizens are not only a basic goal of most governments, they also help ensure a country's internal stability. Using the most recent data from the Arab Barometer surveys (taken in 2015), we found that a shift in satisfaction with healthcare from "Good" to "Very Good" shifted the satisfaction score up 0.68 points on a ten-point scale. Looking at the population segments, we find that poor and unemployed populations are also less satisfied with the Moroccan government. Also, we found satisfaction levels with the government did not change in a statistically significant way before or after the Arab Spring. These findings suggest where (and on who) the Moroccan government should prioritize their resources and policies. Seeing that satisfaction levels with the government have not changed since the Arab Spring suggests that Morocco is not immune to another wave of similar protests, and should motivate the government to take action and improve these scores.

Improving Estimations of Optical Properties in Coastal Ocean Color Modelling

Craig M. Drennan, 2018, Environmental Engineering

Steven Chapra, Civil and Environmental Engineering

Synoptic, satellite-derived estimates of phytoplankton biomass from ocean color have significantly advanced our understanding of biological oceanography. However, the algorithms that translate ocean color to phytoplankton biomass and other water quality metrics have severely diminished accuracy in coastal and estuarine ecosystems due to high and variable concentrations of suspended sediment and dissolved organic matter. Field sampling within the Chesapeake Bay shows indicates particulate backscattering and CDOM absorption significantly covaried as a function of salinity. This field data includes water quality, optical, and in situ remote sensing measurements previously collected from the Choptank River, a Chesapeake Bay estuary, along with the Bay itself in order to sample a broad range of optical and estuarine conditions.

Improvements in the estimation of absorbance and backscattering will significantly improve the performance of current ocean color models in the estimation phytoplankton absorption from satellite imagery in the optically complex waters of the Chesapeake Bay. Towards this end, empirical correlations between these two optical parameters were derived as a function of salinity, to reflect how these parameters change along the Chesapeake Bay estuary. These empirical relationships were then incorporated with spatial salinity data to build a steady-state geospatial model to predict these parameters for summer conditions. This model sets the groundwork for a real-time predictive model to incorporate into day-to-day satellite measurements and can be used to investigate the impacts of larger temporal processes, such as El-Nino Oscillations and climate change, on these optical properties and the field of coastal remote sensing as a whole.

(RE)COVERED IN FRUIT: Unmasking Eating Disorder Recovery Counternarratives in the Internet's Vegan Community

Anna M. Ellis, 2018, Sociology & Psychology

Freeden Blume-Oeur, Sociology

With the proliferation of the online vegan community in recent years, a pattern has become apparent wherein participants consistently reveal histories with eating disorders. Moreover, these individuals claim that their vegan lifestyles facilitate their recovery, contradicting the dominant eating disorder recovery model that condemns dietary restriction. This thesis takes seriously the ways that vegan recoverers, including those with more 'extreme' dietary practices, negotiate their eating disorder recoveries against the prevailing medical model. It draws upon a rich history of eating disorders studies married with social movements theory to extrapolate a new theory positioning vegan recovery as a counterclaim, with a desire to deduce from online blogs the practices that constitute this claim. The data are sourced from 12 online blogs and 13 vlogs created by vegans, selected for their description of an eating disorder narrative, which underwent qualitative analysis for thematic content. Analysis reveals that vegan recoverers craft a counterclaim against pscyhomedical recovery models, asserting their lifestyle as nonpathological while leveraging moral frameworks to do so. They employ numerous techniques to assert the credibility of their claim, relying on embodiment, boundary maintenance, and counterintuitively, scientific paradigms. Finally, in response to multilayered stigmatization, they forge an Internet community that facilitates connection at the expense of full inclusion of others. Summarily, the complex recovery claims, credibility techniques, and community organization allow the vegan recovery community to be situated within social problems and social movements theories. In the absence of previous scholarship examining this community, this thesis contributes both to the sociological literature on social movements and unearths untapped eating disorder counternarratives.

Thermophotovoltaic Cell Characterization through Photoluminescence and Quantum Efficiency Measurements

Lisa F. Fantini, 2018, Engineering Physics

Thomas Vandervelde, Electrical Engineering

Over half of all energy generated is lost as heat before it can be used for its intended purpose. Thermophotovoltaic (TPV) cells intend to solve this problem by converting heat into electricity. An important step in a TPV cell's design process is to characterize it. This means once fabricated, it is critical to test a TPV cell's band gap and quantum efficiency. A TPV cell's photoluminescence spectra, absorption spectra, and produced current help determine these two characteristics and the success of the TPV cell's design and manufacturing. In 2017, I worked on creating a setup to characterize the TPV cells manufactured in Tufts University's Renewable Energy and Applied Photonics (REAP) lab. This exciting new research has the potential to change the world of renewable energy and energy efficiency.

Navigating a Hyperfeminized Profession: The Experience of Masculine Midwives and Their Clients

Max D. Farber, 2018, Fine Art & Sociology

Sarah Pinto, Anthropology

Midwifery today has been recontextualized as subversive within the American medical system. This is in large part due to the gendered, clinical takeover of birth care by the new man-midwives/obstetricians during the 18th and 19th centuries. Reentering the medical system in the early 1900s, midwifery subverted the obstetric conception of the normal, pathological birth, and established a women-centered approach to birth care. In the face of this history, this study asks what happens in the clinical and professional spaces of midwifery when cis-masculine and masculine-of-center folk become midwives. Utilizing mixed purposive and snow-ball sampling strategies, semi-structured, in-depth interviews were conducted with a group of six cis-feminine mothers, and nine midwives (six of whom identified as cis-masculine, and three of whom identified as trans-masculine and/or genderqueer-masculine-of-center). The mothers in this study experienced their pregnancies as inseparable from their identities as cis-women; this translated into their expectations of midwifery care, and their relationships to masculine clinical providers. The mother's experienced a relationship arc with their personal masculine midwifery providers characterized by a positive shift in their perspective on the masculinity of said providers that did not correlate to a global shift in their perception of cis-masculine providers. Midwifery was found to be a hyperfeminized profession that, in some ways, was able to push back against the presence of masculinity unlike other feminine professions. It did not remove the effect of the privilege of masculinity in the profession, but

the masculine midwives of this study did experience a significant push back against their presence. The trans-masculine and genderqueer-masculine-of-center midwives experienced a transphobia characterized by invisibility and isolation within the midwifery community, and a lack of understanding by their cis-feminine counterparts. Unlike the cis-masculine midwives, the queer midwives in this study voiced a distinct desire to create space for, and to support queer and trans patients through midwifery. These results help to define the concept of a "hyperfeminized profession" wherein the structure of the profession is predicated on the presence of feminine agents and recipients of care. The study showed that the subversion of this hyperfeminine space by masculine agents does not counteract the empowerment work of midwifery, and only negatively affected the masculine agents themselves.

Salary Negotiations and the Minority Wage Gap

Zachary A. Finn, 2018, Quantitative Economics & Mathematics

Laura Gee, Economics

A law recently passed in Massachusetts prevents employers from asking about previous wage earnings during salary negotiations. Similar laws have been passed in California and Philadelphia. The law does not prohibit employees from voluntarily disclosing wage history information, but prevents employers from inquiring themselves. The law's intended effect is to halt the perpetuation of discriminatory wages amongst minority groups by preventing previous wage earnings from affecting one's future salary. While the law has not yet been enacted in the state, this research aims at exploring the law's potential effectiveness by implementing behavioral experiments that model a salary negotiation setting. The experiment tests how people act when information about previous wage earnings is varied.

The experiment is based on the ultimatum game in which one participant is given a sum of money and must make an offer, consisting of any fraction of the sum, to another participant. The participant who received the offer can either accept the offer, in which case the money is split based on the offer, or the participant can reject the offer, in which case both participants receive nothing. Online workers were randomly assigned to act as either a manager or a worker. Managers were either given information about the worker or knew nothing about the worker, and then had to make a wage offer to the worker. The worker could either accept or reject this offer. The experiment was designed using the Qualtrics survey system to be implemented on Amazon's online labor market Mechanical Turk. Analyzing the experiment's results would give insight into how employers and employees may act in salary negotiations once the law is put into effect.

The Will to Remember: A Journey Through a Black Family's Life in 20th Century Nashville, TN

Carissa Fleury, 2018, American Studies

Kendra Field, History

This project involves reconstructing the life of my great-grandfather, John Gooch, from his childhood in Nashville as the grandchild of slaves to his migration to California in his 30's. The goal of this project is specifically to analyze his writing and put it in conversation with contemporary academics and histories of Black life in Nashville post-emancipation, especially his "will to remember," as the historian Heather Williams writes. Through examining legal documents, oral histories, and research in Nashville, including visiting the plantation where my family was enslaved and the home that John grew up in, I hope to trace patterns of resistance and the desire to keep family history and memory alive within my family and, in the larger scope, Black Southern families in the 20th century.

R Prime Robot

Charles Frankel, Catherine R. Gao, Robert E. Hendler, Jonathan M. Rooney, 2018, Mechanical Engineering & Quantitative Economics

Chris Rogers, Mechanical Engineering

The project uses an assortment of mechanical design, data communication and interpretation, and human factors aspects to bring the user human-like controls in a separated environment. Principally, the robot's head will move as the user looks around sending 3D image data back into the headset and the robot's arms will move as the VR controllers move. An omni-wheel base supports the arms and head to move nimbly via joysticks on the user's hand controllers. The ability to interact and move via robotic avatar allows the user to be functionally present in previously inaccessible environments, such as space or bomb-defusal scenarios. Additionally, the humanoid mimicry of this robot provides intuitive usage with little-to-no training needed. Ideally the user should feel comfortable acting as the robot with low latency controls to perform a set of tasks such as cutting a wire with grasped scissors. This project has been made possible through the support of Chris Rogers, Jivko Sinapov, and James Intriligator.

Reframing for Reasoning: Eliciting and Evaluating Student Reasoning in Biology Laboratory Reports

Liren Fu, 2018, English & Biology & Minor in Linguistics

Julia Gouvea, Education & Biology

Biology laboratory courses can engage students in deep scientific thinking, enhancing their reasoning and understanding of biological concepts through laboratory experiments (Sundberg & Moncada, 1994; Gasper & Gardner, 2013). This can be particularly evident in laboratory reports, with student writing having been shown to significantly improve critical thinking skills in Biology (Quitadamo & Kurtz, 2007) and being a place to practice scientific argumentation (Kuhn, 2010). However, there have been three obstacles in having laboratory reports engage students in scientific argumentation and reasoning.

Firstly, typical lab reports are often interpreted by students as exercises in reporting findings rather than making an argument (Peker & Wallace, 2009), or that the primary assessment criteria was "answering the question" instead of argumentation and reasoning (Zeegers & Giles, 1996).

Secondly, assessing how students are reasoning in lab reports is a complex and interdisciplinary endeavor, with a multitude of assessment schemes having been proposed in the literature (Sampson & Clark, 2008). However, these assessment schemes can conflate language proficiency with student reasoning, through over-specifying the linguistic format and structure of reasoning (e.g. Lawson et al., 2000).

Thirdly, there exists the fundamental question of what we mean by scientific argumentation and reasoning: what exactly are students supposed to be engaged in, and how do we tell that they are engaging in it?

We conducted our study to investigate whether these three obstacles could be overcome, through explicitly reframing lab report writing as about student reasoning, developing an analytic framework that minimized the effects of language proficiency, and not deciding a priori what would be an ideal reasoning structure. From our data, we propose that simply reframing labs as about demonstrating student reasoning can lead to large increases in demonstrated performance, and that we have a model of student reasoning which minimizes conflation with language proficiency and allows for a better account of the complexity and variation inherent in student reasoning.

Chlorine Taste and Odor Detection and Rejection Thresholds for Beneficiaries in Refugee/ IDP Camps

Mateo Galeano Londoño, 2018, Civil Engineering

Daniele Lantagne, Civil & Environmental Engineering

There are currently 65.3 million forcibly displaced people worldwide, 21.3 million of which are refugees and another 38 million who are internally displaced peoples (IDP). Many of these displaced people reside in refugee/IDP camps, where ease of obtaining essential needs, such as water, is compromised.

Centralized batch chlorination is one of the most widely used methods of water treatment in these high-population density emergency settings. Rather troublingly, however, current guidance upholding this practice is based on municipal water treatment in stable, developed contexts, not evidence from emergency settings.

One of the greatest challenges in chlorination in emergencies is balancing competing criteria of: 1) adequately treating water by meeting its chlorine demand; 2) maintaining sufficient free residual chlorine (FRC) for protecting water during distribution, transport, and household storage through to consumption at the end of the system; 3) not exceeding international maximum guideline values of 4.0-5.0 mg/L of chlorine in drinking water; and, 4) not triggering chlorine taste and odor objections from users. The main goal of this research project is to engage the last part in thorough research.

We urgently need evidence-based guidelines for centralized chlorination in refugee/IDP camps that accounts for both: 1) protection of water through to consumption; and; 2) beneficiary chlorine taste and odor acceptance. Currently, humanitarian agencies are dependent on anecdotal reports of chlorinated water taste and odor thresholds from the field. While anecdotes abound, it is not clear what actual taste and odor thresholds are from a systematic data collection perspective. This research project, therefore, aims to generate evidence on and tools for determining chlorine taste and odor detection and rejection thresholds in order to prevent rejection of safe drinking water in refugee/IDP camps.

An Interview Study of Faculty, Course Assistant, and Student Insight within Teaching and Learning Assistant Programs for Undergraduate Engineering Courses

Hernán Gallegos, 2019, Mechanical Engineering

Kristen Wendell, Mechanical Engineering

This paper explores multiple stakeholders' perspectives on both the TA and LA approaches for instructional assistants. The research question guiding this study is: how do three engineering education stakeholder groups – professors, assistants, and students – experience instructional assistant programs and the changes they influence?

In undergraduate engineering courses, students typically have access to three kinds of resources to succeed: online resources, printed literature, and face-to-face help. "Face-to-face help" is usually with the professor, tutor(s), fellow classmate(s) and instructional assistant(s). Broadly speaking, instructional assistants fall into two main categories: "teaching assistants" (TAs), who typically receive no or minimal pedagogical training, and "learning assistants" (LAs), who are often undergraduate students participating in a pedagogy course to build their skills for helping peers learn and support them in troubleshooting issues of learning. Previous work has studied the impact of LA programs on traditional student learning outcomes (Otero, Pollock, & Finkelstein, 2010), and researchers have begun to explore what motivates TAs (Kajfez & Matusovich, 2017), but few studies have focused on comparing and contrasting experiences and impressions of assistants, professors, and students.

For this qualitative descriptive study, data collection consisted of 15 semi-structured interviews with 7 professors, 5 course assistants, and 3 students from 4 different institutions. Out of these 15 participants, 7 were involved with instructional assistant programs that followed a TA model as described above, and 8 were involved with programs that followed an LA model. Ten of the participants were teaching, assisting, or taking engineering courses, but we also interviewed 5 participants from other STEM disciplines for comparison. The semi-structured interview protocol asked participants to recall their experiences with and knowledge about an LA or TA program with which they had been involved. We transcribed all interviews, and data analysis followed a grounded theory approach (Charmaz, 2006). Using open coding and constant comparative analysis, we identified categories of perceptions and experiences that were common to all three stakeholder groups and that differed across them.

From the analysis of transcripts, we found widespread appreciation for the connections and mentorships that arise from assistant programs, as well as common perceptions that assistant programs support change by enabling shared identities, collaboration, feelings of emotional and intellectual support, critique and feedback pathways, and newfound agency and responsibility. We also identified one widespread theme identifying a major barrier to ideal assistant program implementation: logistical challenges.

These preliminary findings reveal the key role that assistant programs can play in building connections and shared identities between and among stakeholders in a school or department of engineering. This result suggests that a carefully developed assistant program may contribute meaningfully to diversity and inclusion efforts.

Young Adult Attitudes About Global Climate Change: Studying Youth Commitment to Resolving Societal Problems

Sylvie Grenier, 2018, Child Study and Human Development & French

Dr. Richard M. Lerner, Child Study and Human Development

In instances of political and social volatility, it seems almost impossible for people to reach a common ground. Climate change is just one example of such a contentious issue. In an attempt to understand how to better unite diverse groups of individuals, the present study aims to conceptualize the role of identity, attitude, behavior as it relates to the environment and civic participation. Specifically, I examined the associations among young adults' civic identities, multiple domains of pro-environmental behavior, and the role of internal self-regulation in this relationship. French and American young adults (N = 138), ages 18-22, were surveyed in twelve data collections throughout Paris, France and Boston, Massachusetts. Respondents scored highest on measures of civic identity and self-regulation, with lowest scores occurring for pro-environmental behavior. In the total sample, all correlations between study variables were significant. However, the constructs did not vary significantly based on country, gender, or race. Nevertheless, these results illuminate interesting individual and group differences in civic identity, self-regulation, and pro-environmental behavior, particularly given that this study occurred during a period of political transition and social change. Young adults were targeted, as they are on the verge of becoming active members of society as voters, researchers, political leaders, and policy makers who can directly effect change in society. As environmental issues become severe and climate concern continues to grow, knowing how to unite future generations in climate action is critical; future leaders must be able to meet the challenges they will face.

Investigating the Role of HCN4 during Embryogenesis

Hannah L. Harris, 2018, Biology

Kelly McLaughlin, Biology

The complex coordination of numerous signals is required to form a fully functional organism. In order for organogenesis to occur, cells must receive positional information and attain the correct developmental fate. Although the importance of transcription factors and

signaling molecules in developmental processes is more commonly studied, ion channels have also been shown to play instructive roles during embryogenesis. These channels alter the distribution of ions across cellular membranes, generating bioelectric signals that regulate both cellular behaviors and embryonic patterning. We investigated the role of one ion channel, hyperpolarization-activated cyclic nucleotide-gated ion channel 4 (HCN4), during development in *Xenopus laevis*. The physiological function of HCN4 as the adult cardiac pacemaker has been well characterized but this channel is expressed well before the heart begins to beat, suggesting that it may be important for early patterning events. We demonstrate that HCN4 is expressed during early embryogenesis and functions to coordinate the position of the heart in the body cavity. Manipulating channel function resulted in the altered expression of several critical patterning genes and severely mispatterned cardiac tissues. These studies expand what is currently known about how ion channels affect development and highlight the importance of studying novel developmental regulators.

Identification and Characterization of Novel Genes Involved in Glutamatergic Synaptic Signaling and Behavior in *Caenorhabditis elegans*

Julia M. Hofer, 2018, Biochemistry

Peter Juo, Tufts University School of Medicine

This study aimed to characterize the role of the genes lrp-2, neto-1, and C48E7.6 with respect to their potential roles in the mediation of glutamatergic synaptic signaling. In the mammalian central nervous system, glutamate mediates the majority of fast excitatory signaling which plays a key role in synaptic plasticity. Autism Spectrum Disorder, Schizophrenia, and Alzheimer's Disease all have disease pathologies in which faulty glutamatergic signaling is present. The Juo Lab studies glutamatergic signaling using Caenorhabditis elegans and developed a high throughput optogenetic, behavioral screen to identify candidate genes involved in regulating glutamate transmission and the abundance of the glutamate receptor, GLR-1. lrp-2, neto-1, and C48E7.6 were identified, among other genes, in this screen as potential mediators of glutamatergic signaling. In this study, the traditional nose touch behavioral assay, which analyzes the same pathway assayed in the glutamate-dependent optogenetic screen, was used to confirm RNAi results on loss of function mutant worms. The aldicarb neuromuscular junction assay was used to confirm that these genes did not play a role in general synaptic transmission but were instead specifically involved in mediating glutamate-dependent signaling. Fluorescence imaging of transgenic worms expressing GFP-tagged GLR-1 was used to examine the roles these genes played in GLR-1 glutamate receptor localization, trafficking, and abundance.

Clogging in Microfluidic Devices

Sydney W. Holway, 2018, Physics

Timothy Atherton, Physics

Clogging occurs when particles dispersed in a host fluid foul a constriction, interrupting flow. We investigate the regime where geometric effects and not electrochemical attraction between the particles are responsible for the fouling and where the fluid flow is at low Reynolds number. To probe the mechanisms behind clog formation, we used high speed microscopy to observe with sub-millisecond resolution the assembly of particles into a clog. Analyzing the kinematics of clogging particles reveals the formation of a contact force bridge across the channel. Differences between the average particle velocity-position profile and the simple incompressible fluid model reveal a local decoupling of the carrier fluid average velocity from the particle average velocity. By correlating the particle concentration distribution and the velocity distribution, we show that local velocity decoupling results from particle exclusion at the channel walls. Prospects for a microscopic model of clogging incorporating these results are also discussed.

Frictional Reimaginations of the Civic Commons

Emma J. Kahn, 2018, Anthropology

Cathy Stanton, Anthropology

In September of 2016, The J.P.B, John S. and James L. Knight, Kresge and Rockefeller Foundations announced a combined $20 million investment in civic infrastructure (re)development across Detroit, Chicago, Memphis and Akron— after first piloting the collaboration and investment model in Philadelphia. This funding initiative, named "Reimagining the Civic Commons" (R.C.C.), assumes recent trends of social and physical "fragmentation and isolation" in American urban space. R.C.C. then posits social and physical reparation through "(re)activating and connecting" civic assets to yield increased, more equitably shared prosperity. Yet, a myriad of relationships to and imaginations of place undulate within each target community and among those with Civic Commons decision-making power. This heterogeneity also remains archived in the already-existing assets that R.C.C. seeks to reassemble, materially troubling the initiative's assumption of universal and "authentic" relationships to the physical and social landscape. This thesis illustrates how Reimagining the Civic Commons' attempts to build common ground reveal themselves to be ground-breaking, producing fissures through which localized frictions between territorially-preserved legacies of ontological struggle and neoliberal visions of "civic" futures emerge. Ultimately, I pose questions about how the localization of these frictions stands to haunt Reimagining the Civic Commons' desire to produce "new knowledge for American cities."

Mass Disruption and Preference of Cognitive Drug Stimuli of *Physarum*

Daniel Kaltman, 2019, Biology

Dr. Michael Levin, Biology, Allen Discovery Center

Long before the central nervous system (CNS) evolved, both simple and complex organisms were able to learn tasks such as memory, prey-predator recognition, and mate recognition. Learned cognition includes complex cell signaling in all levels of biological organization. Cognition refers to the set of mechanisms and processes that underlie information acquisition, storage, processing, and use, at any level of organization. My previous research on *Physarum* has focused on its ability to migrate towards different nutritional stimuli, such as carbohydrates. Not only did the *Physarum* have preference towards certain carbohydrates, like glucose, they demonstrated their ability to detect larger mass sized food sources. Since the *Physarum* approach the food from a distant, they may possess pressure or gradient "sensors" which attract the *Physarum* towards one food over the other. Here, I present research on the preference of *Physarum* to migrate towards different cognitive drugs, consisting of agonists and antagonists of various neurotransmitters. After analyzing their preference, cognitive assays were conducted to try and alter the cognitive behavior of *Physarum* while injected or plated on the various cognitive drugs. Taken together, this research illustrates the potential ability of early neurotransmitters operating and/or influencing the behavior of an early non-neural organism.

Do Black and White Americans Hold Different Views on Marijuana Legalization? Analyzing the Impact of "The War on Drugs" on Racialized Perceptions of Legalizing Marijuana

Benjamin S. Kaminoff, 2018, Political Science

Natalie Masuoka, Political Science

This study examines whether Black and White Americans develop their views regarding the legalization of marijuana based on different life experiences and, specifically, their involvement with the criminal justice system and drug laws. It aims to investigate if Black Americans generate their views regarding marijuana legalization differently than Whites based on concerns about Blacks as a group and the experiences of Black communities with the criminal justice system. It relies on qualitative interviews of White and Black Americans over the age of 35. The results preliminarily show that while White Americans develop views on legalizing marijuana based on traditional notions of personal freedom and drug abuse, Black Americans generate their views based on "linked fate" conceptions of group interests related to

the history of drug laws and the experiences of Blacks in the criminal justice system. The implications of these findings are discussed.

The Role of Summer Meal Programs for New York City Parents

Allison V. Kannam, 2018, Community Health

Keren Ladin, Occupational Therapy

Only 15 percent of U.S. children who receive free and reduced-price lunches during the year access USDA-sponsored free summer meal programs when school is out of session. Previous research has explored parent perceptions of summer meals to understand the underutilization of the program. The present study aimed to explore the perceived role that summer meal programs have for families. The study drew upon participating families' experiences and non-participating families' perceptions of the program's potential benefits through twenty qualitative semi-structured phone interviews with parents from Queens, Bronx, and Brooklyn, New York. All interview respondents were recruited through their participation in a separate summer meals survey at their child's elementary school, where they offered their contact information for follow-up. The interview asked questions about the challenges providing food in the summer and the perceived benefits or barriers to participating in a free meals program. Interviews were transcribed, coded, and analyzed thematically. Results demonstrated that summer meals reduce financial and psychological stress for parents, build social capital in the community, and improve consumption habits for children. However, some meal programs may lack cultural inclusivity, preventing families with religious dietary restrictions from participating. On the whole, while the main purpose of summer meals is to reduce food insecurity, the programs provide many additional social and psychological benefits that demonstrate their value in the community. Summer meal administrators should incorporate messaging about these advantages into their marketing to leverage support for and participation in the programs, while meal sites should continue innovating ways to improve access to meals for all families.

An Investigation into Methods for Electrospinning Poly(ether ether ketone)

Thomas Keller, 2018, Applied Physics

Prof. Peggy Cebe, Physics

Poly(ether ether ketone) (PEEK) is a high-performance thermoplastic polymer. First commercialized by Imperial Chemical Industries PLC (ICI) in 1978, PEEK has been employed in a number of diverse applications due to its exceptional thermal, mechanical, and chemical properties. As a thermoplastic, PEEK can be heated past its melting point into a liquid and then

cooled back to a solid state, allowing it to be manufactured into molded parts, seals, films, and fibers. Related research into electrospinning similar polymers, a method by which small fibers are manufactured using static high-voltages, has yielded fibers of single micron diameters. However, despite research into similar polymers, no method has been published to date for producing PEEK fibers using electrospinning. The reason for this is largely due to PEEK's outstanding thermal, mechanical, and chemical characteristics, which make it both desirable for applications in industry and challenging to manufacture. This presentation outlines a first-of-its-kind technique for electrospinning PEEK fibers, and details some novel characteristics of the resulting fibers. Investigating methods of electrospinning PEEK is critical for understanding its potential applications in micro-scale fiber technologies such as filtration and textiles. This cutting-edge approach to producing PEEK fibers on the micron and sub-micron level will hopefully open new doors in both science and industry for the betterment of humanity.

Growth of Points on Hyperelliptic Curves

Christopher Keyes, 2018, Mathematics

Robert Lemke Oliver, Mathematics

Algebraic curves, arising as solutions of polynomial equations, have been studied by mathematicians for centuries. Some familiar examples are lines, circles, and elliptic curves. Of particular interest to number theorists are the rational points on these curves. These are the points satisfying the defining equation for which each coordinate is a rational number, or integer fraction. In this work, we explore the rational points on hyperelliptic curves, a more general family of algebraic curves. In 1983, Faltings showed that hyperelliptic curves, and in fact all algebraic curves with genus greater than 2, have only finitely many rational points.

What would happen if we relaxed the definition of rational, by allowing certain irrational numbers to appear in the coordinates? Now we are considering the curve over a number field. Faltings' theorem also applies in this setting, so the number of points will still be finite, but will it grow? The answer is: sometimes. A natural follow up question is: how often will it grow? In this presentation, we will share new results for counting the number fields of a given degree that admit new points over a fixed hyperelliptic curve, for certain degrees. We will describe some of the techniques used in answering these questions as well as some motivation for future work.

Ambient Energy Matrix Isolation Spectroscopy

Thien T. Khuu, 2018, Chemistry, English

Mary Jane Shultz, Chemistry

Interaction between p-toluenesulfonic acid (pTSA) and water is studied at-20 °C in a CCl_4 matrix. In CCl_4 water exists as monomers with restricted rotational motion about its symmetry axis. Additionally, CCl_4 is transparent in the hydrogen-bonded region; CCl_4 thus constitutes an excellent ambient thermal energy matrix isolation medium for diagnosing interactions with water. Introducing $(pTSA)(H_2O)_2$ gives rise to two narrow resonances at 3642 cm^{-1} and at 2835 cm^{-1} plus a broad 3000–3550 cm^{-1} absorption. In addition, negative monomer symmetric and asymmetric stretch features relative to nominally dry CCl_4 indicate that fewer water monomers exist in the cooled (-20 °C) acid solution than in room-temperature anhydrous CCl_4. The negative peaks along with the broad absorption band indicate that water monomers are incorporated into clusters. The 3642 cm^{-1} resonance is assigned to the OH-π interaction with a cluster containing many water molecules per acid molecule. The 2835 cm^{-1} resonance is assigned to the (S-)O−H stretch of pTSA-dihydrate. The coexistence of these two species provides insights into interactions in this acid−water CCl_4 system.

Developing and Teaching an Anti-Bias Curriculum in a K-5 School: Leadership, Teachers', and Young Children's Experiences

Anna M. Kimura, 2018, Child Study and Human Development & Minor in Asian American Studies

Ellen Pinderhughes, Child Study and Human Development

In US schools, a common colorblind philosophy assumes that young children do not see differences among people, and thus these differences do not need to be discussed during the early childhood period (ages 3-8) (Hirschfeld, 2012). However, children's awareness of differences among people develops as early as three months old (Sangrigoli & Schonen, 2004), and by preschool, children begin to hold biased beliefs (York, 2016). In order for children to learn how to process these differences in ways that are respectful of self and others, it is imperative that children are taught appropriate language, and actively practice discussing these differences in healthy, productive ways through anti-bias education. The goal of anti-bias education is to help all children reach their fullest potential (Derman-Sparks & Edwards, 2010).

The purpose of this study is to examine a development and implementation process of an anti-bias curriculum at *Eastwood Elementary School. My research question is: How did Eastwood Elementary School's staff design and implement a developmentally appropriate, race-conscious, anti-bias curriculum that effectively engages students in its early childhood

classrooms? The research methodology is a case study, constructed using interview and classroom observation data. The findings confirm several critical tenets of anti-bias education: the importance of strong leadership, teacher self-reflection, and a collaborative team culture. The children's comprehension of anti-bias concepts not only debunks the colorblind myth, but also demonstrates how anti-bias language, such as empathy and discrimination, can be taught in developmentally appropriate ways during the early childhood period. The findings also illustrate how adults who may initially be uncomfortable discussing anti-bias topics can, through a progression of steps, learn ways to engage with and teach these topics to children. The implication of these findings is that anti-bias education at a larger institutional scale is possible.

*School name changed to preserve confidentiality.

The Impact of Animal-Assisted Interventions on Armenian Youth

Nairi Krafian, 2018, Biopsychology

Susan Higgins, Occupational Therapy

Nairi Krafian is an Armenian-American undergraduate student pursuing a degree in biopsychology. She is interested in the impact of animal-assisted interventions (AAIs) on people. Later this year, she will conduct an outcome measure to determine the efficacy of the AAI program she created in Armenia, called Oknooshoon. The program was implemented at the Fund for Armenian Relief Children's Support Center, a residential crisis relief center for children in need of safe and reliable care. Nairi is currently completing an independent study through the Occupational Therapy Department under the advisory of Dr. Susan Higgins, a licensed Occupational Therapist with expertise in AAIs, in order to prepare this outcome measure. The independent study includes a review of literature related to AAI in children and adolescents with social and emotional challenges, and a program proposal that will describe the program and the outcome measure. Specifically, it will address how and why the program was implemented, and how its efficacy will be measured. The outcome measure aims to determine if there is an immediate social or emotional impact of AAI on the Oknooshoon participants. Changes in social and emotional state will be measured by identical pre- and post-intervention self-report questionnaires. The questionnaires will measure emotional state by levels of fear, anxiety, anger, and sadness, and social state by levels of loneliness. The hypothesis, based on the body of pre-existing literature, is that both emotional and social state will improve after AAI, with decreased levels of sadness, anxiety, fear, anger, and loneliness. This outcome measure intends to provide knowledge to generate hypotheses for future research to be conducted through the International Veterinary Medicine program at The Cummings School of Veterinary Medicine. Future research will follow up and expand on the present study by examining long-term impacts of AAI in Armenia through longitudinal studies.

Emergence of Systematic Structure in CTSL

Leyla Kursat, 2018, Cognitive and Brain Science

Ray Jackendoff, Center for Cognitive Studies

Emerging sign languages can show how linguistic complexity arises, by allowing researchers to observe the structure, or lack thereof, of a language in its infancy. Central Taurus Sign Language (CTSL), first studied by Dr. Rabia Ergin, is an emerging sign language in an isolated village in Southern Turkey uninfluenced by any other language. Jackendoff and Wittenberg suggest a hierarchy of grammars in which simpler grammars rely on pragmatics and discourse context for comprehension. CTSL lies in the lower levels of this hierarchy. By exploring its reliance on pragmatics, this project investigates the balance between grammar and pragmatics. We studied recorded videos of CTSL signers describing complex situations in which they have to distinguish semantically similar objects and agents. We found common strategies such as finger tracking, abstract location and scene setting, and we explored use of negation and modifiers through looking at word order. The systematic use of these strategies indicates a developing structure over generations of signers. The paths of development show the extent to which CTSL has climbed up the grammatical hierarchy.

The Investigation of Data-Analytic Methodologies for Wealth Distributions

Chengli Li, 2018, Applied Math & Economics

Bruce Boghosian, Mathematics

Wealth distributions are dynamic and wealth is concentrating. The purpose of this research is to understand how the parameters in our model would affect the wealth distributions. More specifically, the validation of our mathematical models of wealth distribution using methods of data analytics by gathering actual wealth distribution data and finding the model parameters that are most consistent with it. The wealth distribution data from the European Central Bank (ECB) for fifteen European countries will be analyzed in the context of our models.

Formulating Silk Patches for Skeletal Muscle Repair

Schuyler Link, 2018, Biomedical Engineering

Lauren Black and Whitney Stoppel, Biomedical Engineering

Traumatic injuries caused by events such as vehicle accidents or compound bone fractures can cause extreme damage to muscle tissue. Though muscle generally has a robust healing response, grievous injury constituting Volumetric Muscle Loss (VML) can overwhelm the tissue's regenerative ability and leave a permanent functional deficit. Currently limited options for recovery exist aside from extensive physical therapy and muscle grafts from other parts of the body, which are clinically accompanied by donor site morbidity or eventual amputation. Advances in tissue engineering have created new opportunities for treatments that use engineered muscle to replace the lost tissue, though a critical difficulty in creating these constructs is a lack of perfusion in thicker engineered tissues. To this end, we are developing an engineered muscle tissue using a thin, silk based biomaterial as a substrate for a co-culture of human skeletal muscle cells and endothelial cells (Lonza®) to create an engineered tissue with an integrated vascular network that can interface with host muscle to prevent necrosis in the implant. Results demonstrate that human skeletal muscle and endothelial cells respond differently to media formulations aimed at promoting either growth and expansion or differentiation and maturation within the engineered muscle tissue within the 3D engineered tissue construct. Furthermore, we have optimized silk biomaterials formulations to contain collagen, adult porcine skeletal extracellular matrix, or fetal porcine skeletal extracellular matrix, aiming to determine the biomaterial composition that promote both skeletal muscle differentiation and maturation while also enabling vessel formation. Results demonstrate the tunability of this scaffold platform in directing cell phenotypes and protein expression

Identification of Host Immunological Pathways in the Resolution of *Babesia microti* Infection

Shant H. Mahrokhian, 2018, Biology

Edouard Vannier, Geographic Medicine and Infectious Disease

Immunocompetent individuals infected with *Babesia microti* typically experience a mild illness or no symptoms, and develop antibodies against the parasite. Whether these antibodies contribute to host resistance remains unknown. Immunocompromised patients, on the other hand, are prone to experience severe babesiosis. Those who are or were recently treated with rituximab, a monoclonal antibody that depletes mature B cells, are at risk of relapsing babesiosis. In these patients, resolution of infection requires extended antibiotic therapy and has coincided with seroconversion. The lab previously uncovered that B cells are critical for the resolution of parasitemia in *cd4*-deficient mice, and that titers of IgG antibodies rise

concomitantly with the resolution of parasitemia. Absence of B cells imposed by *igh6* deletion or repeated administration of anti-CD20 prevented parasitemia resolution in *cd4*-deficient mice. To ascertain whether IgG mediate protection conferred by B cells, we generated *cd4*-deficient mice that lack *aicda*, the enzyme required for antibody class switch and somatic hypermutation. In these mice, parasitemia persisted although a modest decline was transiently observed. Current efforts aim at identifying *B. microti* antigens recognized by IgM in *cd4-aicda*-deficient mice. We conclude that i) IgG, and possibly IgM, protect from persistent parasitemia in immunocompromised hosts and ii) neutralization of a restricted set of *B. microti* antigens targeted by these antibodies may be sufficient to resolve and clear *B. microti* infection in the immunocompromised.

Fear, Unsettled; Poe, Wilde, and Gothic Anxiety

Sabrina Manero, 2018, English

Nathan Wolff, English

My research focused primarily on the short stories of Edgar Allan Poe and Oscar Wilde's novel, The Picture of Dorian Gray. Through these works, I explored the rise of the sensation of unsettlement in gothic literature. I chose Oscar Wilde and Edgar Allan Poe as both authors create a distinctively self-reflexive transatlantic strain of gothic writing that has not previously been unaccounted for. Though the gothic genre is often hailed as being female in authorial presence and content matter, the choice of two male authors is intentional. Wilde's perspective as a queer author musing on the relationships of two men in regards to art and Poe's preoccupation with aesthetics and the figure of the unobtainable woman can be read in conjunction to create a space for a conversation about psychoanalysis and gender. Using Sianne Ngai's Ugly Feelings as my theoretical lens, along with the political criticism of Siân Silyn Roberts, I concluded that the interaction between language and syntax creates a space in which the unsettling gains a stronger presence in gothic literature than that of fear. I propose that the idea of experiencing disorienting discomfort, akin to that of Sigmund Freud's "The Uncanny," is a result of what I refer to as "the unsettling". Fear, however, dominates the genre in two specific iterations, terror and horror. Ann Radcliffe writes of the distinction between the two, with terror heralded as being morally good and horror as the embodiment of the morally evil. I believe that the unsettling falls in the space between the two as a morally grey yet prevalent affective experience.

The Effect of Alkyl Chain Length on Mechanochromic Dialkylester Substituted Phynelene Ethynylene Oligomers

Arielle S. Mann, 2018, ACS-Certified Chemistry

Samuel Thomas, Chemistry

Phenylene ethynylenes (PEs) are remarkable in that they can change their geometric conformation from planar to twisted while under pressure, which results in surprising yet reproducible and reversible pressure-induced changes in solid-state absorbance and fluorescence. The three ring phenylene ethynylenes compound synthesized with perfluoroaromatic side chains not conjugated to the main chain have been shown to exhibit substituent effects on side chain to main chain interactions resulting from competing non-covalent interactions. This is accomplished through the fluoroarene-arene interactions which allows for tunability of the fluorescence in the mechanochromic response, the changing of color with the application of a mechanical force.

The appendage of alkyl chains to terminal esters on these PEs bearing non-conjugated pentafluoroaromatic rings impacts the interactions of the fluoroarene-arene interactions. As the alkyl chain length increase, there is a decrease in heat-recovery temperature from the ground to the annealed phase. This occurs due to the crystallinity of the ground phase decreasing due to weaker interactions. Additionally, the longer the alkyl chain, the farther apart molecules are in their solid packing. This allows for the decrease in thermal energy needed for the material to revert from its ground conformation back to its original annealed phase.

The Rate of Modern Sea Level Rise in Boston

Jacob A. Marsh, 2018, Geological Sciences

Dr. Andrew Kemp, Earth and Ocean Sciences

Modern sea level rise is a threat to coastal communities around the globe. Through a comparison of modern sea level rise rates to historic rates, we can understand the severity of sea level changes today and infer what processes might be the cause of local changes. To estimate historic sea level rise rates over the past 3,000 to 4,000 years, sediment cores from a local salt marsh were dated using carbon isotope values and analyzed for their foraminifera content. Given their narrow habitable ranges in salt marshes, foraminifera assemblages provided an indicator of past sea level measurements at points along the core. Using the Boston tide gauge as a data point for the 20th century rate of sea level rise, the estimated modern rate was compared to historic sea level rise rates in Boston derived from the sediment cores. Modern sea level rise was found to be accelerated when compared to the past several thousand years, and this change is likely a result of anthropogenic activity.

Concentrating Platelets: From Bench Success to Therapeutic Relevance

Angelo Massaro, 2018, Biomedical Engineering

David L. Kaplan and Alessandra Balduini, Biomedical Engineering and University of Pavia Department of Molecular Medicine

Thrombocytopenia, a condition in which individuals have a low platelet count, like many other hematologic diseases is treated by platelet transfusion. Platelet transfusions, however, are in limited supply and patient access to this therapy can be minimal in certain circumstances. For this reason many research institutions are now working to better understand the pathway by which Megakaryocytes produce platelets. Researchers are trying to generate platelets in vitro with the eventual goal of therapy for patients with thrombocyte deficiencies. Thus far, a number of labs (e.g. Pallotta et al. 2011) have successfully produced platelets from Megakaryocytes but, in many cases the obtained platelets are far too diluted in the resultant culture media. This project aims to design a device which can interface with a platelet producing bioreactor and bring the cell suspension to a physiologically relevant concentration for potential use in therapy. This is particularly challenging because platelets are small (1-3 μm) and can easily undergo activation upon a variety of stimuli.

Finite Presentability of Groups

Ruth Meadow-MacLeod, 2018, Math & Physics & Art

Kim Ruane, Mathematics

My research is about a specific method of showing groups to be not finitely presented, which involves looking all finite sub-presentations and showing them to have properties different from the group itself. The initial goal was to look at the finitely generated infinite torsion groups. It isn't currently known if such groups can be finitely presented, so the goal was to see if I could show that they are always not finitely presented by looking at groups acting on trees. First, I examined a not finitely presented group that acts on the ternary tree. Then I started getting away from group actions on trees, and focused more on the method of proof. I looked at the lamplighter group, and showed it to be not finitely presented using this method. After that, I tried to use this method on the group which is the kernel of the map from F2 x F2 into Z that takes all the generators to 1. This group is known to be not finitely presented, so the goal was to show it in a new way using this method. I've made some progress in the proof, but have not yet succeeded.

Effects of mutations in Osteogenesis Imperfecta on structural stability of collagen

Arya Mekkat, 2018, Mathematics

Yu-Shan Lin, Chemistry

Collagen is a major component of the extracellular matrix and provides physical support for cells and organs. Collagen also interacts with a diverse array of proteins, such as integrin, and has an active role in extracellular matrix construction and remodeling, cell migration and cell adhesion. Type I collagen, the most abundant of the 28 types of collagen, is found in skin and tendons and is a heterotrimeric triple-helical peptide composed of two α1(I) chains and one α2(I) chain. The collagen sequence is also composed of glycine-X-Y triplet motifs, where X and Y represent amino acids. Mutations in the collagen sequence often disrupt the triple helix structure and are associated with various diseases. For example, the replacement of glycine with serine is the most common substitution mutation in Osteogenesis Imperfecta, an autosomal dominant genetic bone disorder.

Heterotrimeric collagen is currently challenging to synthesize; consequently, experimental studies have largely focused on characterizing the effect of mutations in homotrimer α1(I)3 collagen. To better investigate the effects of mutations on type I collagen, this study applied molecular dynamics simulations to model type I collagen heterotrimers consisting of two α1(I) chains and one α2(I) chain. To understand how glycine to serine mutations affect the triple-helical structure of collagen at binding sites, the model collagen peptides consisted of the integrin-binding site GFOGER and 6 triplets N- and C-terminal to it. The first glycine on the integrin-binding site (GFOGER) was then mutated on one, two, or all three collagen chains. This study found that a single mutation on the α2(I) chain resulted in a greater disruption of inter-chain hydrogen bonds than a single mutation on either of the α1(I) chains. Furthermore, a single mutation had the largest reduction in triple helix stability, and additional mutations on multiple chains did not necessarily have additive effects. Additional simulations were also performed to elucidate the molecular origin of this observation.

"Fall and Fallout": The Narrative Language of Paradise Lost

Pranav A. Menon, 2018, English

Ichiro Takayoshi, English

This project investigates how the temporal and paradigmatic duality and dichotomy of Paradise Lost is smoothed out and reconciled by Milton's use of narrative structures and form. By addressing the historical moment in which the poem was written and the revolutionary aims of the poet, the project argues that Paradise Lost represents a transitionary text between

premodern and modern understandings of humanity in the Christian world, and furthermore, that the poem is partly responsible for creating that modern world. The project takes a linear "trek" through the three acts of the poem and explores how narratives and narrative techniques help bridge the gap between two radically different perspectives and how this transitionary motion ultimately helps satisfy the personal desires of the poet in a unified, homogenous text. It is, in many respects, an attempt to tell a story about Paradise Lost, which the critical tradition has shown to be a story about stories in and of itself.

Madam Senator: Political Visibility and Identity-Based Attacks Online

Shaan Merchant, 2019, Interdisciplinary Studies: Media and Politics & Spanish

Sarah Sobieraj, Sociology

Resistance to women's public voice and visibility via street harassment and workplace sexual harassment have long constrained women's use of and comfort in physical public spaces; this gender-based resistance now extends into digital arenas. Women and people of color face extreme hostility in the form of digital sexism and racism in discussion rooms, comment sections, gaming communities, and on social media platforms. This is particularly true of women holding elected office. This paper mines @mentions on Twitter to showcase the different responses faced by male and female leaders who enter digital publics, showing the remarkable patterned resistance women, particularly women of color, face when they hold positions of authority. In light of these findings, we argue that we must consider the democratic costs of gender-based harassment, in addition to the personal ones.

Exploring the Role of Pfam Families in Protein Function

Daniel J. Meyer, 2018, Computer Science

Lenore Cowen, Computer Science

It is widely accepted that the structure of proteins determine their function. Many computational inference methods that act on proteins or sets of proteins rely on assigned functional labels from a popular ontology, often the Gene Ontology (GO). While informative motif information leveraging structure is already captured in libraries of Hidden Markov Models (HMMs), such as Pfam, creating a useful Pfam to GO mapping remains a difficult endeavor. This is because, not only is it a many-to-many mapping, but also, different Pfam-derived domain annotations within a protein structure, either individually, or as a set, might yield different amounts of specificity in regards to the set of possible GO labels that are appropriate. Estimating the amount of specificity that a single, or set of, Pfam-derived domains gives, in

regards to GO labeling, is confounded by the unequal representation and/or the lack of coverage of annotation in both domains across the protein universe.

We revisit issues of sequence patterns, diversity, and representation in the light of all the new data in current sequence databases. We have developed a suite of parsers and an Object-Relational Mapping using Python and SQLAlchemy to represent selected information of proteins and families from the UniProt and Pfam databases respectively, while making it easy to access and reason about information stored in the graphical structures of the GO and Evidence Code Ontology (ECO). We use this framework to compare dcGO (Fang and Gough, 2013) and GODM (Alborzi et al., 2017), which are designed to optimize different tradeoffs for coverage versus false-positives.

Legacies of the Anglo-Hashemite Relationship in Jordan

Julie E. Murray, 2018, International Relations & Middle Eastern Studies

Thomas Abowd, Anthropology/American Studies

In this paper, I argue that the independent political entity of Jordan was created chiefly in order to serve British imperial interests in the Middle East, which happened to coincide with the Hashemite desire for an Arab state. In the first chapter on the historical context of the British Mandate in Transjordan, I analyze Britain's intentions for the Jordan, how those intentions came to be, and how those intentions are exacted onto the territory. In the following chapters, I examine the significance of Jordan's borders and the border delineation process in the context of Britain's relationships with Jordan's neighbors, and I explore the connection this geographical state-formation has to the political state-formation of Jordan. While the origin of the Jordanian state and its borders may have been incidental in nature, I contend that after the establishment of Transjordan, there was a concerted effort made by the ruling Anglo-Hashemite government to build legitimacy and consolidate the state, primarily through the development of the Arab Legion and the integration of the Bedouin tribes into the state. I claim that this effort was successful, as evidenced by the existence to this day and relative (to the other Middle Eastern states created in the wake of the Ottoman Empire's demise) political stability of the Hashemite regime in Amman.

Infrared Spectra and the Coverage of Molecules on Surfaces of Solid Catalysts

Trang T. Ngo, 2019, Chemical Engineering

Prashant Deshlahra, Chemical and Biological Engineering

Chemical reactions occurring on solid catalysts are indispensable to our energy and chemicals infrastructure. Infrared spectroscopy, a powerful tool for understanding reaction mechanisms by probing reactive species on catalyst surfaces, is unable to quantify the precise number of such species because dipole-coupling, a phenomenon in which surface molecules cross-communicate with their neighbors, strongly affects the intensity of spectra. In this project, we seek to develop mathematical parameters to model such dipole coupling effects. A quantitative model will promote a more effective use of infrared spectroscopy for characterizations of catalytic materials, leading to the development of better catalysts for energy-efficient processes.

Taking a Queer Pulse: The Impact of Medical Structure on Healthcare for Non-Binary Patients in Boston

Neeki Parsa, 2018, Sociology

Freeden Blume Oeur, Sociology

Individuals with non-binary gender identities must pass through medical bureaucracy to meet their healthcare needs. The present study sought to understand the associated experiences by employing semi-structured interviews in the Greater Boston Area for seventeen non-binary individuals. Non-binary medical patients are often faced with highly bureaucratized medical systems with intake forms without sufficient opportunity to reflect their gender identity, and insurance companies that have exclusive stipulations for transition-related care. Furthermore, physicians which are not a part of clinical systems labeled as "queer-friendly" are often not sufficiently educated on non-binary gender identity. The poor cultural competence that precipitates results in non-binary patients' avoidance of care, and acquisition of transition-related information in online community spaces before healthcare spaces. For participants with disabilities, or who were chronically in pain or chronically ill, it was not uncommon for participants to limit disclosure of associated symptoms or experiences to facilitate "getting in and out" of the doctor's office. Lastly, participants expressed hesitance to disclose their gender identity because of the expectation that they may have to exert emotional labor for physicians who do not understand gender; this entailed participants expecting to have to manage their own emotions as they explain their gender identity, or as they experience instances of discrimination from physicians. The present study adds to literature on LGBTQ+ health using sociological theory by elucidating a few social facets of the non-binary medical experience.

A 3D Bioengineered Model of Intestinal Immunity to Modulate Pathogen Transcytosis

Harry T. Paul, 2019, Biochemistry & Community Health

Dr. David Kaplan, Biomedical Engineering

Since the gastrointestinal tract is in contact with the outside world, the defenses of the human epithelium against pathogens is of paramount importance to human health. Mucosal immunity relies both on the innate defense actions of antimicrobial peptides and on inflammation created by macrophages and Paneth cells. Adaptive immunity in the intestine is more complicated, with presentation of antigens carefully regulated by immune-surveillance posts known as M-cells which are scattered in low numbers throughout the intestine and which pass certain antigens through to adaptive immune cells lying beneath its surface. Due to their low numbers and selective differentiation, these cells have not been reliably cultured in in vitro in physiologic conditions despite their relevance to toxicity and disease modulation efforts. This work focuses on the differentiation of human intestinal stem cells to M-cell fate in the context of a previously developed in vitro model of the intestine which recapitulates tight junction formation, oxygen gradients, enzyme secretion, and innate anti-bacterial responses to infection. Initial efforts to differentiate towards M-cell fate are confirmed by qPCR and analyzed by immunostaining. Future plans on the use of a 3D model containing M-cells to measure how transcytosis action is modulated in the normal and diseased states, and the use of co-cultures to determine evidence for M-cells as the start of the IBD inflammatory pathway are also presented.

"Not the American We Dreamed Of:" Identity, Belonging, and Citizenship of Latinx Immigrants in Donald Trump's America

Sophie Pearlman, 2018, Sociology & Peace and Justice Studies

Orly Clerge, Sociology

The 2016 US presidential election brought an onslaught of attacks on marginalized groups throughout the country, including Latinx immigrants. I aim to understand, explore, and tell the stories of Latin American immigrants living on Long Island, New York during this particular political moment. This research attempts to understand their interactions with institutions and relationships to their own identities in the current national political climate. I base my findings in Latino Critical Theory as well as sociological theories of identity and segmented assimilation.

Focus group-style interviews were performed with a total of 15 participants, all of whom were members of the same church community. These individuals were a mix of documented

and undocumented, and all of them were born in Central or South America. The results shed light on the day-to-day sociopolitical experiences of these Latin American immigrants during and since Donald Trump's 2016 presidential election. First, by emphasizing the "welcoming ethos" of America and placing the blame for the country's current anti-immigrant climate on Trump the participants found ways to create glimpses of hope during a grim time. However, this led to the transformation of the American dream from one of success to one of mere existence within the country. Second, mobility and visibility has changed as all Latinx individuals interviewed, not just those without documents, were forced to limit their mobility and visibility in society even more than before. Third, the abilities to enforce immigration policies of the Trump administration have been unofficially extended to white American citizens, who actively threatened the participants of this study. The findings of this research are significant as they detail a political moment that, up until now, has been minimally research through academic means.

In vitro characterization of TRPA1-mediated acute pain and wound healing in a silk-based cornea model

Rachel E. Pollard, 2018, Biochemistry

David Kaplan, Biomedical Engineering

The cornea, being the most innervated external tissue in the human body, is an ideal tissue for studying pain responses. However, there are limitations, ethical and otherwise, regarding the use of animal models to study pain. Therefore, the development of an in vitro model that encapsulates the physiology of the human cornea and its sensory innervation is of critical value. The 3D in vitro silk-based cornea model developed by Wang et al. (2017) is a novel tool for studying pain in the cornea as it is the first engineered cornea model to incorporate epithelium, keratocytes, and human sensory nerves in 3D scaffolding. Here, this model was used to characterize the acute pain and wound healing process in response to stimulation with mustard oil (allyl isothiocyanate, AITC) a potent transient receptor potential ankyrin 1(TRPA1) agonist. RT-qPCR was used to examine the temporal aspect of wound healing along with the interplay between the neurons and the epithelium and stroma. Secretion of pain-mediating neuropeptides Substance P (SP) and calcitonin gene related peptide (CGRP) were monitored using ELISA. It was found that mustard oil induced a physiological pain response in the cornea model, including upregulation of matrix metalloprotease 9 (MMP9), scar formation markers collagen type 3A1 (COL3) and smooth muscle alpha-2 actin (ACTA2), and inflammation factors interleukins 1-alpha, 1-beta, and 6 (IL1a, IL1b, IL6). This characterization of TRPA1-mediated pain in the cornea shows that this model is a viable tool for studying pain responses in vitro in a holistic, high throughput-like manner.

The Impact of a Short-Term Mindfulness Induction on Experiential Avoidance

Marina Rakhilin, 2018, Clinical Psychology

Heather Urry, Psychology

Previous research suggests that mindfulness holds promise as a treatment for anxiety-related disorders because it aids individuals in lowering their experiential avoidance (EA). In other words, mindfulness helps individuals approach anxiety-inducing stimuli, thus allowing for extinction of the fear response. The current study is a partial replication of a previous study (Carlin & Ahrens, 2014) designed to investigate whether engaging in a brief mindfulness induction may result in decreased avoidance behavior. Undergraduate students were randomly assigned to listen to focused breathing audio or mind-wandering audio. They were then shown a fear-inducing clip. This study expands previous research by measuring avoidance behavior via three distinct indicators: persistence in a frustrating math task, willingness to repeat the frustrating math task, and latency before starting the math task. This study explores two questions: 1) whether a mindfulness induction inhibits experiential avoidance across all three aforementioned markers of EA, and 2) whether trait mindfulness moderates the effect of a mindfulness induction on experiential avoidance.

Modeling Oxygen Tensions, Biomass Generation, and Cellular Phenotypes in 3D Silk Sponges Cultured Under Perfusion

Adam C. Rayfield, 2018, Biomedical Engineering

Lauren Black, Biomedical Engineering

Myocardial infarction and resulting heart injury occur following an ischemic event, where the muscle tissue is deprived of oxygen. Engineered models of healthy and diseased cardiac tissues can aid in development of both clinical and pharmaceutical treatments. However, a better understanding of cell behavior in three-dimensional systems is necessary to recapitulate the disease process. Specifically, changes in cell signaling, gene expression, and extracellular matrix remodeling are known to occur following ischemic injury, which can be induced in vitro via culture under hypoxia. To aid in design of bioreactors for 3D engineered tissue culture, mathematical models for fluid mechanics, oxygen diffusion and uptake, and cellular growth are computationally simulated using COMSOL®. This computational model was built with the goal of determining appropriate parameters to generate tunable hypoxic regions at the center of an engineered cardiac tissue. Parameters for the model have been informed by experiments with cell growth under hypoxia and by those used in prior research. Results from the simulations presented herein have informed experimental design parameters such as perfusion rate, the density of perfusion channels, and the dimensions needed for a bioreactor

system. Future work aims to validate these computational results via in vitro experiments with a 3D cardiac tissue.

A New Music-Medicine: Participatory Affective Musical Experience in Clinical Settings

Eleanor T. Rimmerman, 2018, Music

Alessandra Campana, Music

It has been widely recognized that music, like medicine, can be a type of performative healing. The body experiences heightened sensory affect when engaging in emotionally-stimulating music and thus music can be part of an alternative medicinal practice. Yet scientists tend to generalize "music" and limit its use according to the so-called "music therapy," the only healing method that bridges music and medicine. The current music therapy treatments adopted in hospitals are problematic, especially because patients are exposed only to a small repertoire from the Western musical canon (the "Mozart Effect" is one famous example). This approach to healing fails to consider patients who may not connect and thus not benefit from this type of music. Moreover, there is often a hierarchical relationship between the music therapist and the patient wherein therapists present music to patients. Music can sometimes exhibit a deleterious effect on a patient's health and well-being if the healthcare provider is not sensitive to each patient's unique sociocultural background.

This paper proposes a new music model in which a designated physical space is created within the hospital for patients and caregivers alike to engage in musical activities and experiences aimed at addressing the patients' diverse sociocultural background. This model reduces the therapist-patient hierarchy by introducing a participatory-type engagement between both the therapist and the patient. Therefore, my model proposes a way for aligning both musical and medicinal practices to performance and community, by encouraging a patient's participatory engagement.

The Reassignment Problem

Eli Rosmarin, 2020, Computer Science & Quantitative Economics

Lenore Cowen, Computer Science

The reassignment problem is our name for a set of assignment problems that are defined in reference to a preexisting initial assignment. For example, for a set of n people assigned to n houses, we consider reassignments that either never place a person into a house they like less than their currently assigned house, or alternatively consider reassignments

where a bound is placed on the number of people whose new assignment violates this constraint. We find that budgeted weighted perfect re-matching is NP-hard, but we are able to give a polynomial time algorithm for budgeted unweighted perfect re-matching. We connect this work to related literature that considers markets for barter and exchange, discuss generalizations, and open problems. This is joint work with Tara Kola and Professor Lenore Cowen.

Associations between Cognitive Impairment and Symptom Severity in Schizophrenia and Schizoaffective Disorder Using CANTAB

Aliyah S. Sanders, 2018, Clinical Psychology

Kamber Hart, Massachusetts General Hospital

Cognitive impairments are a central feature of schizophrenia. However, severity of impairment differs by individual, as well as within the domain of impairment. Prior investigations have suggested that the domain of impairment may correlate with symptom domains, but this relationship is not well understood. The National Institute of Mental Health (NIMH) has developed a 5-factor model of psychotic symptoms within the Positive and Negative Syndrome Scale (PANSS) to characterize symptom severity among populations that experience psychosis-spectrum disorders. Thus, we sought to examine the relationship between these symptom factors and 11 cognitive measures from the Cambridge Neuropsychological Test Automated Battery (CANTAB) and the Wechsler Abbreviated Scale of Intelligence (WASI) in 81 participants diagnosed with schizophrenia or schizoaffective disorder. We used linear regression models to evaluate the relationship between the cognitive assessments and each symptom factor controlling for covariates. Participants with high scores on the negative symptoms factor had slower reaction times ($p=0.00541$), an increased number of declarative memory errors ($p=0.02953$), and their problem solving abilities decreased ($p=0.00191$). Participants with high scores on the disorganized/concrete factor had worse performance on an emotion recognition task ($p=0.00502$), and their word knowledge/verbal concept formation decreased ($p=0.000216$). As scores increased on the excited factor, emotion recognition abilities decreased ($p=0.042$). These results support previous assertions that cognition is related to psychosis symptom severity, while providing further evidence for a relationship between individual cognitive impairment and specific symptom factors. Future investigations might seek to highlight the ways in which cognitive performance improves over time, in order to evaluate whether symptoms across these subdomains change with long-term treatment.

Children's Ability to Causally Reason about Emotions across Development

Sara J. Schiff, 2018, Psychology

Paul Muentener, Psychology

This study investigated the development of children's understanding of the causes of emotions. Prior research demonstrates that children are capable of differentiating between various emotions and can recognize emotions in others. The present study extends these findings to explore whether or not young children can recognize and understand that emotions can be caused by something external (ie., in the surrounding environment). Ninety-six participants comprised 6 six-month age groups from 12-48 months old. Participants watched two types of puppet shows: Causal and Non Causal. In the Causal shows, a target toy scared the puppet, and in the Non Causal shows, a target toy did not scare the puppet. The experimenter then presented the participants with four toys (including the target toy) and asked participants to play with the toys, determine how to make the puppet feel better when it is scared, and identify which toy made the puppet scared. We assessed participants' causal reasoning based on their predictive looking, play, and interventions. The results of this study suggested that children as young as 1-3 years are not fully capable of causally reasoning about emotions and only exhibit mastery of components skills of causal reasoning about emotions. Further research should be conducted to better understand how young children use causal reasoning with emotions.

Borehole Functionality by Management and Spatial Characteristics in the Eastern Region, Ghana

Olivia L. Schultes, 2018, Community Health

Karen Kosinski, Community Health

Water systems such as boreholes (drilled wells) are crucial to expanding access to safe water sources in rural areas. Water systems in rural areas have mainly relied on community management and have often failed to ensure adequate administrative capacity and financial management skills. There is also evidence that the spatial distribution of boreholes and other unimproved water sources can influence motivation to fix broken systems. This has resulted in high rates of non-functionality; in Africa, for instance, there have been documented failure rates of 18% - 59%. In this study, water infrastructure, housing, and survey data were collected from 15 towns in the Eastern Region of Ghana. Borehole functionality was examined using longitudinal data from 3 years. Borehole functionality was then examined by management and spatial characteristics. Results will help external organizations evaluate potential infrastructure locations, establish effective management structures, and provide administrative support.

Synthesis, Characterization, and Reactivity Studies of a Cobalt-Centered Aminopyridine Macrocyclic Catalyst

Henry D. Seidel, 2018, Biochemistry

Elena Rybak-Akimova and Terry Haas, Chemistry

Oxidation reactions and catalysts that conduct these reactions are often topics of interest for chemists due to the search for alternative energy sources. Catalysts that use environmentally friendly oxidants such as hydrogen peroxide are of particular interest. The Rybak-Akimova group in the Tufts Chemistry Department uses aminopyridine macrocyclic complexes with varying pendant arms to mimic the coordination geometry of biological agents and study the mechanisms and kinetics governing oxidation reactions. The complexes we use contain transition metal centers that are particularly nontoxic, "green," and inexpensive. One specific complex of interest is the cobalt-centered macrocyclic complex that is functionalized with a carboxylate pendant arm. Analogous iron-centered complexes have been shown to be catalytically active; however, they are often unstable and susceptible to rust. The cobalt complex is hypothesized to be similarly catalytically active, but more stable and well behaved. The synthesis of the functionalized cobalt complex (CoL6a) involves a five-step reaction sequence. Characterization of CoL6a has been performed with IR spectroscopy, X-ray crystallography, and elemental analysis. Furthermore, recent reactivity studied have shown CoL6a's ability to catalyze phenol oxidation reactions, specifically, involving the substrate 3,5-di-tert-butylcatechol.

Disparities of Justice Across Adversarial Lines in New England

Ani E. Soultanian, 2018, Sociology

Dr. Jill Weinberg, Sociology

Although the term justice is uttered daily in courts across the nation, it is seldom defined. In criminal courts, both prosecutors and defense attorneys are tasked to "do justice." Because their training and experiences vary, it is reasonable that their perceptions of justice evolve and differ over time. In the age of mass incarceration, it is critical to explore concepts such as justice which inform criminal sentencing. Over the course of several months, I conducted ethnographic work in a New England courthouse before interviewing the prosecutors, defense attorneys, judges, and detectives I observed. After analyzing the subsequent qualitative and quantitative data, different trends emerged among the opposing groups. Prosecutors were far more likely than defense attorneys to express positive attitudes toward the criminal justice system and its players. However, both adversarial parties were more likely to find culpability when murder defendants were older and victims appeared especially vulnerable. Though more evidence is needed, the results represent different ways that

professional obligations and experiences as well as societal attitudes manifest among those who make decisions that impact the lives of criminal defendants. Each interview participant gave a different set of suggestions for improving the criminal justice system, though most were more inspirational or utopian at best. However, suggestions that include greater cooperation among adversaries may be both plausible and beneficial to defendants and society.

Cytokines and How They Induce Tim3 and PD1 in Melanoma Cells

Edith H. Statham, 2020, Biochemistry

Tobias Schatton, Harvard Institute of Medicine

Both Tim3 and PD1 are receptors that are known to be expressed on T-cells and play an integral role in immune system suppression. In recent years it has become apparent that both of these receptors are also being expressed on melanoma cells lines, but their role and functioning on these cancerous cells is still somewhat of a mystery. In an effort to better understand these two receptors and how they function on melanoma cells lines, we sought to map the different cytokines that induced Tim3, PD1, and their ligands, PDL1 and PDL2 on six different cell lines. First, we sought to determine which cytokine receptors were expressed on these cells lines; the presence of the receptor would act as an indication that the cytokine could affect PD1 and Tim3 activity. The presence of the receptor was determined using quantitative Polymerase Chain Reaction (qPCR). After narrowing down list of cytokines that could affect Tim3 and PD1, the cells were treated with the various cytokine candidates for various amounts of time. In order to get a more in depth understanding of cytokines and how they affect Tim3 and PD1, these treated cells were then analyzed at the gene expression level using qPCR and on the protein level using flow cytometry. By analyzing all this data, we are beginning to uncover which cytokines play a central role in inducing Tim3 and PD1 in Melanoma Cells Lines.

History and Memory of Chilean Unions

Emma K. Steiner, 2018, International Relations & Spanish

Peter Winn, History

An exploration in to memory and how it relates to history for Chilean labor unions. My research uses historical analysis, discourse analysis and memory studies to trace the continuity of challenges to progress throughout the history of Chilean labor unions and compares the history of continuity to memory and individual's conceptions of their organization's past and present. Division, political tension, and individualism are challenges labor unions have fought since their conception. However, many labor leaders discuss these topics as if they are new, and furthermore, insurmountable problems. My research suggests that these challenges are

neither new nor insurmountable and their conception as such is a product of memory. Instead, these challenges have been rooted in the nature of unions since their conception and create a constant internal battle for progress.

Minimizing Bangs Generated by Autobahn for Haskell Programs Using GHC Profiling Feedback

Marilyn L. Sun, 2019, Computer Science

Kathleen Fisher, Computer Science

In a programming language with lazy evaluation such as Haskell, program expressions are only evaluated when the system determines their values are necessary for producing the desired result. While lazy evaluation has many advantages, it can result in serious performance costs. Fortunately, Haskell allows users to enforce eager evaluation at certain program points by inserting bangs, which are strictness annotations. However, manual placement of bangs is both labor intensive and difficult to reason about.

As a response, the Autobahn optimizer was previously created to automatically infer bang patterns that improve runtime performance using genetic algorithms. However, Autobahn often generated copious amounts of bangs for each program. This is an issue for the user because each bang that cannot be deemed safe by the GHC compiler required manual inspection to prevent the bang from introducing program non-termination.

We created a minimizer for Autobahn, which reduces the number of unnecessary bangs generated by Autobahn by using GHC profiling feedback. The GHC time and allocation profiling report identifies how much time and memory was used at each cost center location in the source code. The minimizer keeps track of the cost centers that use up the most resources and independently groups and tests all the bangs in those resource-draining cost centers. Groups of bangs that effectively improve program runtime are retained, and groups that minimally impact program runtime are discarded. As a result, the minimizer greatly decreases the number of bangs in a program while roughly maintaining the same amount of runtime performance. Autobahn used in conjunction with the minimizer allows users to obtain faster versions of their programs without the burden of manually checking through large amounts of bangs.

Modeling Damage Scenarios: An Analysis of How Damage Function Specification Affects the Optimal Carbon Price

Andrew R. Takasugi, 2018, Quantitative Economics & Environmental Studies

Gilbert Metcalf, Economics

My project is an analysis of the ways in which adjusting damage function specification effects integrated assessment model output. My main concern is the effect on the carbon price, an estimate of the marginal social cost of carbon, which measures the sum of the market and externality costs associated with carbon usage. I start with a discussion of DICE 2016, a model that estimates economic damages from climate change by relating economic and environmental variables to each other. I go on to adjust DICE to model a set of alternate damage scenarios that are proposed in recent academic literature. Specifically, I focus on one scenario in which damages are applied to the growth of output, and a second in which damages become catastrophic after a temperature based tipping point is crossed. After modeling each scenario I undertake a sensitivity analysis and model decomposition to consider how changes to key characteristics of the damage function affect the estimates.

Comparing Objective and Subjective Measures of Inattention That Predict Forgetting

McKinzey G. Torrance, 2019, Cognitive and Brain Science

Elizabeth Race, Psychology

Fluctuations in attention can impact whether information is encoded into memory. However, it is currently unclear whether different behavioral or subjective measures of inattention accurately predict forgetting (deBettencourt et al., 2017; Maillet & Schacter, 2016). The current study investigated whether different subjective and objective measures of inattention predict subsequent memory, and the degree to which these measures are modulated by individual differences in trait levels of inattention (i.e., propensity to mind wander). Participants performed an incidental encoding task and were periodically cued to self-report their subjective attentional state. Trait levels of inattention were measured by a battery of questionnaires. Subjective measures of inattention (off-task reports during memory encoding) positively correlated with trait levels of inattention across individuals. In contrast, objective measures of inattention (mean RT) did not correlate with trait levels of inattention. Objective measures of inattention also predicted forgetting, but only across participants and not for individual items within subjects. These results link objective measures of inattention to memory and indicate that objective measures of inattention may be a stronger predictor of later forgetting than subjective measures across individuals. However, more sensitive

behavioral measures may better capture moment-to-moment fluctuations in attention that impair encoding.

Noise-Induced Changes in Finch Song Revealed by Bone Conduction

Colin A. Trimmer, 2018, Cognitive and Brain Sciences

Mimi Kao, Biology

My project investigates auditory learning in the zebra finch. In this species song production relies on the auditory feedback loop to learn a complex song that is unique to every individual. This process is of special interest to neurologists and behaviorists alike. Zebra finches are valuable models to study the basis of motor learning, auditory perception and language. My work examines the temporary effects of removing auditory feedback. It may have application to people who stutter. New technologies have made this experiment possible.

Targeting the MCL-1-BL3 Domain Protein-Protein Interaction with Small, Cyclic Peptides

Lauren D. Varanese, 2019, Biochemistry

Joshua Kritzer, Chemistry

The BCL-2 family of proteins regulates apoptosis, programmed cell death. Some proteins in this family such as MCL-1 are anti-apoptotic; they bind to the BLC-2 homology region (BL3) of pro-apoptotic proteins and prevent cell death. The overexpression of MCL-1 in cells is one of the contributing factors to the development of some cancers. Targeting and inhibiting MCL-1 to increase apoptosis is one possible treatment for some cancers. However, MCL-1 has proven hard to target. Drug molecules must be able to interact with MCL-1 in a shallow surface area, and must also be bioavailable. Peptides are now being explored as potential drug molecules because of their flexibility and ability to bind to larger areas. Linear peptides can be too flexible and unstructured, resulting in a low binding affinity for their target. Cyclizing—or "stapling"—these small peptides can "lock" a peptide into a specific secondary structure such as an alpha helix, and can lead to increased stability and bioavailability. This project focuses on using a new stapling chemistry from the Kritzer lab on peptides and finding the peptide with the strongest affinity for MCL-1. The goal of this project to find a cyclic peptide that has an increased binding affinity with MCL-1 compared to the linear peptide. The project aims to show that this new stapling chemistry is a useful method for peptide cyclization. This new stapling technique could add a myriad of new peptide conformation possibilities for future drug molecules.

Understanding how Protein-Protein Interaction Distance Metrics can be used in Disease-Gene Prioritization

Zachary S. Wallace, 2018, Applied Mathematics

Lenore J Cowen, Computer Science

For thousands of genes and proteins, we now have data that predicts which pairs of them are interacting. We can represent this data as a network where the nodes are genes or proteins, and the edges capture experimental evidence that participating nodes or genes are interacting. This defines Protein-Protein Interaction (PPI) networks. Independently, for particular complex diseases such as Alzheimer's or Diabetes, we know some of the genes that are important actors for these diseases. Over the past decade there has been research regarding the use of PPI data to assist in the computational predicting of additional but yet unknown genes associated with a disease of interest. We look at whether re-weighting PPI networks based on Diffusion State Distance (DSD) or the Resistance Distance (RD) between any two genes in the network can improve existing algorithms for predicting disease-gene associations. Both of these theoretical distance metrics are useful for understanding how protein interactions are clustered within the network. We propose re-weighting these PPI networks by eliminating edges of the complete DSD or RD graphs through a Minimum Spanning Tree algorithm and then re-adding appropriate edges back to the network based on a DSD or RD threshold value of choice. Using this method to re-weight the protein interaction network preserves underlying cluster structure so it can capture communities of disease genes.

Implicit Ambivalent Racist Sexism: An Intersectional Approach to Racial and Gender Bias

Megan Q. Warshawsky, 2018, Psychology

Keith Maddox, Psychology

Recent publicity of sexual misconduct (e.g., O'Brien & Segall, 2017) often fails to address the impacts of ambivalent sexism and intersectionality on implicit sexist associations. 'Ambivalent sexism' posits two disparate valences of sexism, perceptually negative 'hostile sexism' and positive 'benevolent sexism' (Glick & Fiske, 1996). Intersectionality theory posits specific consequences for Women of Color (Crenshaw, 1989) including varied perceptions of femininity across race ('gendered race theory,'; Schug et al., 2017) and unique prejudices targeting Black women ('misogynoir,'; Bailey, 2010). Such are often overlooked due to lacking social salience of oppressed groups like Black women ('invisibility'; Books, 1998; Fryberg & Townsend, 2008). As racial competence was not incorporated in the original testing of ambivalent sexist theory (Glick & Fiske, 1996), this study chooses to investigate implicit

ambivalent sexist associations toward Black and White women. In light of intersectional theories (Bailey, 2010; Schug et al., 2017), the current hypothesis predicted that benevolent sexism would have a significantly stronger association with White women as compared to Black women. MTurk Participants (N=188) completed an Implicit Association Task (IAT). Results indicate a significant and large effect supporting the original hypothesis. Potential limitations and future directions are discussed. Overall, the findings suggest a nuanced relationship between ambivalent sexism and race. Future research should explore the relationships between implicit racism, implicit sexism, and explicit judgment and behavior toward Black and White women.

Keywords: ambivalent sexism, implicit, race, intersectionality, invisibility, misogynoir, IAT

Battle of the Regenerative Agriculture vs. Climate Smart Agriculture Paradigms in the age of Climate-induced Agricultural Reform

Josephine H. Watson, 2018, Environmental Studies & Political Science

Anne Marie Codur, Tufts Global Development and Environment Institute

This policy brief aims at shedding some light on the main issues at stake in the rethinking of agriculture that is being discussed at the international level through this new climate lens considering soils as a primary carbon storage strategy. Using our observations from attending the COP23, we will define in more detail these two paradigms and detail the mechanism through which the United Nations instigates reform, and compare each paradigm's respective influence on Agricultural project development.

Biological Denitrification in Porous Media

Aaron Watts, 2018, Chemical and Biological Engineering

Andrew Ramsburg, Civil and Environmental Engineering

Heavy use of fertilizer in commercial agriculture has resulted in large amounts of nitrogen pollution in the form of nitrate. The EPA currently lists the Maximum Contaminant Level Goal (MCLG) at 45 milligrams of nitrate per liter. This goal is being rapidly approached or exceeded in many areas in the United States and around the world. Indigenous microbial species have the potential to remove nitrate pollution by reducing it to dinitrogen (N_2) gas in a process known as denitri cation. Biological denitrification is advantageous because it does not require large capital and energy costs associated with highly engineered systems. Biological transformation of nitrogen is challenging because a suitable environment must be created to facilitate complete denitri cation without the accumulation of the more toxic nitrite ion or the

greenhouse gas, nitrous oxide. The motivation of this work is to investigate and develop a numerical model capable of describing the fate and transport of nitrogen species in sandy porous media. A firm understanding of the reactive kinetics and the experimental design for this continuous flow system will serve as a starting point for subsequent analysis of the synergistic relationship between pharmaceutical degradation and denitrification.

Lessons Learned from a Community-Based Participatory Research Collaboration between the Medford Family Network and Tufts University

Seblewongel Yigletu, 2020, Community Health

Shalini Tendulkar, Community Health

There are currently 43.3 million immigrants in the US and this number continues to rise. Immigrant families face disproportionate socioeconomic and health burdens with the current political climate challenging service provider's engagement with these communities. Community-academic research partnership may offer value in better understanding these and other challenges and ultimately inform strategies to address them. Community-based participatory research (CBPR) is the practice of leveraging the resources, first-hand experiences, and personal relationships of community partners with the research experience of students and faculty at Tufts. This abstract presents the lessons learned from MATCH (Medford and Tufts Community Health), a classroom-based collaboration between the Medford Family Network (MFN), an organization serving families and children, and an undergraduate student-faculty team. The goal of the Spring 2018 CBPR project was to better understand how to engage immigrant parents of children 0-8 years old in services through data collected in the form of focus groups with immigrant families and semi-structured interviews with immigrant service providers in the community. We identified several lessons. First, community-academic partnerships provide a great learning opportunity for both community partners and undergraduate students. In particular, community input and involvement in the research process can enhance research validity. Second, discussing mutual expectations for work and developing concrete and achievable timelines can support successful partnerships. Finally, it is imperative that students recognize that community partners face many demands on their time. It is crucial that teams discuss how to ensure the authentic engagement of community partners in the research process utilizing strategies such as regular meetings and updates and efforts to develop relationships with partners. Both community partners and research institutions should strive to work side by side, in equitable collaboration to better understand how to make the most positive and lasting impact in their communities.

Partnering with North Suffolk Mental Health to Increase Access to Cancer Prevention, Early Detection, and Treatment

YooJin Yoon, 2019, Biology & Community Health

Kelly Irwin, MD, Massachusetts General Hospital Cancer Outcomes Research Program (CORe)

Background: Individuals with serious mental illness (SMI) experience markedly increased cancer mortality due to delays in diagnosis and inequities in treatment. People with SMI face unique barriers to cancer care, including uncontrolled psychiatric symptoms, fragmentation of mental health and cancer care, and stigma impacting healthcare delivery. These challenges are compounded by disproportionate poverty, limited health literacy, and cultural barriers to care in communities served by North Suffolk Mental Health and Mass General (MGH) community health centers.

Method: To increase access to high-quality cancer care, MGH collaborated with North Suffolk to identify individuals at high risk for cancer and individuals with a recent/previous cancer diagnosis. We conducted educational sessions and outreach at multiple levels including mental health clinicians, administrations, residential, and community staff. Nursing staff on the medical services team met with residential staff leaders and collaborated with MGH to develop a population-based system to track referrals and increase access to cancer care and clinical trials.

Result: From June 2017 through January 2018, we received 49 referrals of patients with SMI at high risk for cancer or previously/recently diagnosed with cancer. We partnered with North Suffolk staff to access screening and oncology care. Examples include collaborating with group home staff to facilitate a same-day diagnostic mammogram and conducting joint meetings with MGH oncology to guide end of life care discussions.

Conclusions: Patient-centered approaches, collaboration between the cancer center and mental health, community engagement and population-based tracking are promising strategies to promote equitable cancer care for patients with SMI from underserved communities.

Synthesis and Characterization of Manganese(II) Aminopyridine Catalysts for Environmentally-Friendly Olefin Epoxidation

Adam Zoll, 2018, ACS-Certified Chemistry & Spanish

Elena Rybak-Akimova and Terry Haas, Chemistry

Inspired by oxidative enzymatic processes in living systems, chemists have performed extensive studies of catalytic methods that mimic those found in biology to generate epoxides more efficiently. Two closely related manganese(II) aminopyridine complexes were synthesized,

characterized, and investigated with respect to their catalytic performance on olefin epoxidation. In attempts to improve the performance of manganese catalysts, electron-donating substituents were added to the picolyl arms of the *rac*-PYBP precursor ligand to produce a novel "super-rich" analog of the chiral PYBP ligand which was hypothesized to better stabilize the metal center of the complex. Crystal structures of the ligands were obtained, and EPR spectra were analyzed to further investigate the structural and electronic reasons for differences in catalytic performance. This project contributes to the body of works related to the field of structure-activity relationships of new inorganic catalysts and advances green chemistry by replacing toxic metal elements and reagents with a biologically benign metal (Mn) and an environmentally-friendly oxidant (H_2O_2).