Predoctoral Fellowship Awards 2018

Monday, April 9, 2018

Rackham Graduate School

The Rackham Predoctoral Fellowship is one of the most prestigious awards given to graduate students by the Rackham Graduate School. Those selected for this twelve-month fellowship have advanced to candidacy and are anticipating finishing their Ph.D. within six years of beginning their studies. The award takes into consideration professional papers and presentations, publications, honors, as well as academic standing. This booklet contains the dissertation abstracts of all the 2018-19 Predoctoral Fellows.

The Rackham Predoctoral Fellowships are supported by the Horace Rackham Endowment which was created in 1935 by a gift to the University of Michigan from the Horace and Mary Rackham Fund. More than 2,200 doctoral students have received this fellowship since it was established.

Jubilee Adeoye
Civil and Environmental Engineering

Application of Engineered Cementitious Composites for Enhanced Geologic CO2 Storage Security

Geological carbon sequestration (GCS) has been identified as a promising approach to slow global climate change caused by CO2 emission. GCS has the potential to store large quantities of CO2, but its long-term success as a carbon mitigation strategy may be derailed by leakage of CO2 from the reservoir through wellbores, as a result of compromised cementing material. Hence, alternative wellbore cementing materials that can withstand the chemical attacks from CO2-acidified solutions and mechanical stresses due to CO2 injection are being investigated. This research project focuses on the study of a novel fiber-based Engineered cementitious composite (ECC). ECC has tensile properties superior to conventional concrete and Portland cement and presents the potential for cracks to selfheal following reaction with CO2-rich solutions, making it a prime candidate for wellbore cementing operations under GCS conditions.

Talha Ali
Epidemiology

Social Network Typologies and Health of Older Adults: A Multidimensional Approach

Older adults are one of the fastest growing population subgroups and also at a higher risk for many mortal and morbid events compared to other age groups. Their health status and survival is determined, to a large extent, by the relationships that form their social network. However, social network is often perceived as a distal exposure and conceptualized as a unidimensional construct in the epidemiologic literature. Using data from a longitudinal, population-based study of older adults, this dissertation moves beyond unidimensional characterization of social relationships by employing latent class analysis to construct social network "types" of older adults. It broadens the scope of existing research by (i) simultaneously taking into account the structure, function, and quality of relationships in the construction of network types, and by (ii) extending evidence for the beneficial effects of social embeddedness beyond emotional health and behavioral outcomes to the longitudinal effect of social network types on functional and cognitive health. Identification of major network types among older adults can subsequently inform development of relevant risk assessment tools and public health interventions.

Alena Aniskiewicz
Slavic Languages and Literatures

Cultural Remix: Polish Hip-Hop and the Sampling of Heritage

This dissertation argues that within Polish hip-hop, the citation of canonical poetic texts and the invocation of national literary icons serve as a means by which Polish rappers and their fans negotiate their role in local and global communities. Reading the recordings of Polish rappers and fan discourse alongside the literary texts they cite, I contend that in identifying the artists who memorialized the tumultuous 19th and 20th centuries, Polish hip-hop establishes a lineage of national struggle and poetic resistance – a lineage in which it presents itself as a contemporary incarnation. In so doing, Polish rappers reframe the conventions of hip-hop—usually associated with marginalized communities within a nation—casting Poland itself as the oppressed subject, thus reaffirming national myths, reanimating poetic texts as complex and contested expressions of contemporary Polishness, and offering a novel perspective on how belonging and authenticity are negotiated and performed in popular culture.

James Antonaglia
Physics

Physics of Two-Dimensional Polygon Crystals

The synthesis of nanoparticles and colloids with anisotropic interactions and intricate shapes has led to the production of a wide variety of complex self-assembled soft matter phases. We construct theoretical minimal models to predict mechanical properties and of possible self-assembled phases. We use computer simulations both to verify universal quantities such as critical scaling laws and to extract non-universal mechanical properties away from critical points such as elastic moduli and mechanical mode dispersion relations. We explore the mechanical modes of two-dimensional systems of hard polygons. Close to their melting densities, Kosterlitz-Thouless-like critical behavior dominates and mechanical constants are largely universal. Near dense packing, some hard particles exhibit chiral symmetry breaking, and we explore and explain this transition with a minimal mechanical model. In both contexts, we find librational waves and particle symmetry determine a structure's properties and phases.

Christian Axelgard
Classical Studies

Tragedy and Identity in Fourth-Century BCE Athens

Contradictions surround Lycurgus' canonization of Athenian tragedy in the 330s BCE; numerous public figures starting in the fifth century BCE called tragedy's contribution to the polis into question. The fourth-century political decision to present the genre as the height of Athenian cultural achievement therefore demands reconciliation. In particular, Isocrates and Aristotle complicate the fourth century's reception of tragedy as a patriotic and praise genre. Oratorical, philosophical, and historical sources, supported by epigraphical and archaeological evidence for the fourth-century popularity of tragedy throughout the Greek-speaking world, elucidate the difficulties that tragedy's often non-Greek content posed for an Athens seeking to reclaim her celebrated creation. Comparison with similar efforts to canonize art forms in Rome and 20th-century America suggests a universal appeal in celebrating simultaneous political and artistic achievement.

Anat Belasen
Ecology and Evolutionary Biology

Interacting wildlife stressors: The effects of genetic diversity loss on disease susceptibility in fragmented amphibian populations

Emerging infectious disease is responsible for widespread declines in a number of animal groups. In amphibians, disease-associated declines are largely seen as enigmatic. This is in part because the mechanisms leading to wide variation in disease susceptibility observed within and among host species remain poorly understood. In my dissertation research, I test the hypothesis that loss of genetic diversity due to landuse change and habitat fragmentation drive the differences we observe in disease susceptibility within and among amphibian populations. In Chapter 1, I examined the long-term impacts of isolation and inbreeding using a historically fragmented model system of ~12-20,000 year old land-bridge islands. Long-term fragmentation not only caused overall genetic diversity loss, but also reductions in diversity at a genetic region related to immune function. Inbred populations also hosted more infections. In Chapter 2, I investigated a second mechanism by which inbreeding may compromise health: the host-associated microbiome. I found that inbred island populations hosted reduced microbiome diversity, which is likely to compromise disease resistance. To improve the applicability of my research to recently fragmented populations, I then examined frog populations from two recently (~200 ya) fragmented landscapes: (1) forest fragments in a sea of intensive agriculture (Chapter 3), and (2) forest fragments within an agroforestry matrix (Chapter 4). In these two areas, I sampled a diversity of host amphibian species to also examine any impacts of host ecology on genetic diversity loss and susceptibility to disease. My findings have important implications for the management of vulnerable populations in biodiversity hotspots.

Marcus Berger
Linguistics

The Syntax of Co-Reference in Bora

This dissertation contributes to current linguistic theory by analyzing original fieldwork data collected from an understudied, endangered Amazonian language, Bora. The Bora language has around 2,500 speakers remaining, and is at a critical point for documentation. As is the case with all endangered languages, once there are no speakers remaining, we do not know what knowledge about human linguistic capacity we are losing with it. Based on original fieldwork, my work will contribute to linguistic theory by showing that the subjects of subordinate clauses in Bora are typologically unlike many widely spoken languages. Using this data, I point out ways in which current theory cannot account for Bora subordinate clauses, and suggest ways the theory can be revised to account for this data. The results of my fieldwork also include an annotated collection of primary Bora data, including stories and cultural traditions for use by researchers and future Bora generations.

Secil Binboga
Architecture

Designing the Region: Infrastructures of Development and the Making of Cold War Turkey

This dissertation assembles a spatial history of Modern Turkey by looking at key realms of built environment that were radically altered during the Cold War period, such as agricultural lands and river systems. In particular, it studies three interconnected investments, funded by the International Bank for Reconstruction and Development, under the auspices of the U.S. Mission in Turkey: a soil survey map, a hydro-engineering project, and a port reconstruction plan. Each of these investments was distinct in terms of the alterations it produced in landscapes and waterscapes. And yet I examine them as orchestrated efforts to construct an eastern Mediterranean region, known as "Çukurova" (hollow plain). Questioning the ideological and economic dynamics that accompanied Turkey's assimilation into both the "new Middle East" and the American sphere of influence, I aim to show how designed relations between nature, labor, and capital at this particular setting were entangled in complex geopolitical transformations.

Jamie Budnick
Sociology

The New Gay Science: Sexuality Knowledge, Demography, and the Politics of Population Measurement

The last decade witnessed an unprecedented prioritization of research on non-heterosexuality, fueling activism ("data=power!") and LGBTQ civil rights. Political upheaval and contemporary skepticism toward expertise leaves this sexuality knowledge in a precarious position. My dissertation leverages the surge of interest in the demography of sexuality to show how social scientific thinking shapes policy, and vice versa. I draw on STS approaches to the politics of knowledge, the sociology of quantification and classification, survey methodology, and feminist epistemology to tell the stories of five prominent knowledge claims about non-heterosexuality. I use comparative-historical and interview methods to investigate how knowledge claims about non-heterosexuality circulate out in the world in public discourse and policy debates, and interrogate their technical production within social science, specifically demography. My case demonstrates the continued relevance, contested legitimacy, and sociopolitical influence of sexuality knowledge – as well as the high stakes of social science expertise on the national stage.

Cristian Capotescu
History

Giving in the Time of Socialism: Humanitarianism, Economic Life, and Mobility in Postwar Europe

My dissertation investigates moments of state crisis in socialism as catalysts for humanitarian action. I analyze how Romania's turn to economic austerity in the late 1970s spurred the rise of non-professional aid practitioners—"private humanitarians"—across Europe who organized welfare assistance for Romanians in need through clandestine supply conduits. My dissertation contributes new insights to some of the most vexing debates in current global and area studies: 1) it scrutinizes the impact of globalization on the socialist societies of Eastern Europe prior to the economic restructuring of the region through "shock therapy" in the 1990s; 2) it explores how private humanitarians operated under socialism outside of, and indeed as an informal ersatz structure to, the welfare state since the late 1970s; and 3) it investigates the broader effects of neoliberalism on socialism by exploring the relationship between austerity economics, social unrest, and regime collapse in Romania in 1989.

Liam Casey
Chemical Engineering

Deciphering the mechanisms of nanoparticle-induced antigen-specific immune tolerance and engineering nanoparticles for improved safety and efficacy

The incidence of autoimmune diseases is steadily increasing, highlighting the emerging need for new immune treatment strategies. Unfortunately, current treatments for immune disorders are not curative and only mitigate symptoms using broad-acting immune suppression. In experimental models, polymeric nanoparticles have demonstrated reversal of autoimmunity by enforcing antigen-specific immune tolerance (suppression of autoreactive cells while preserving healthy immunity). However, the mechanism of action for these particles remains unclear. Furthermore, antigen-loaded nanoparticle platforms suffer from shortcomings that may limit their translation to human applications. Here, the role of liver antigen presenting cells in particle-induced tolerance is investigated to inform nanoparticle design parameters. Antigen-polymer conjugate nanoparticles were engineered to reduce uncontrolled antigen release, minimize undesired immune recognition, and achieve unprecedented antigen loading. The efficacy of these particles was improved by co-delivering the anti-inflammatory protein TGF-β on the surface of the particles, which resulted in reprogramming of immune cells and improved tolerance efficiency.

Rose Cersonsky
Macromolecular Science and Engineering

Designing Particle Shapes for Self-Assembly of Novel Colloidal Crystals

The design of new materials has often relied on crystal structure as a source for design complexity and innovation. This requires new crystal structures and new manners of constructing and synthesizing these structures. An ideal mechanism for synthesis is self-assembly, the spontaneous emergence of order due to particle interactions. On the nanometer length scale, particle shape can drive or often dominate the self-assembly behavior of a system. Engineering the shape of nanoparticles can enable self-assembly driven by entropy to obtain colloidal crystals. Using Digital Alchemy, a framework which provides theoretical thermodynamic interpretation of particle shape, we can obtain optimal particle shapes through simulation for assembling target structures, and use these results to understand the role of particle shape in stabilizing colloidal crystals. In doing so, we are not limited to target only structures, but also materials properties, furthering the understanding of the interplay between materials synthesis, structure, and properties.

Chun Wa Chan
History of Art

Female Sovereign, Immigrant Technocrats: The Opportunity of Buddhism in Early Japan

My dissertation examines the roles of a female emperor and immigrant technocrats in the development of early Buddhism in Japan. When the religion was introduced to Japan during the Asuka period (592-710 CE), it was perceived not only as a belief system, but also as a gateway through which cultural and technical knowledge from continental East Asia was imported. Coinciding with the rise of Japan's first female emperor, Suiko (r. 593-628), and large-scale population migration from the Asian mainland to Japan, the introduction of Buddhism operated as a portal that allowed these social groups to negotiate their political ambitions and cultural statuses. Organized around two case studies, my project underscores how art history can significantly reshape our understanding of early Japan, whose cultural and racial complexities have often been silenced by historical texts written from patriarchal and xenophobic points of view.

Cornelius Cilliers
Chemical Engineering

Improving antibody tumor distribution and efficacy through single-cell imaging and multi-scale modeling

Despite the widespread use of antibody-based therapeutics, the relationship between the heterogeneous distribution of antibodies in tumors and their overall efficacy is incompletely understood. In the first part of this thesis, we characterize the residualization properties of common near-infrared (NIR) fluorophores and labeled antibodies to study antibody distribution with high spatial and temporal resolution. We then present a novel dual label technique to quantify antibody distribution and metabolism in vivo with unprecedented single cell resolution. Next, we develop a multiscale modeling framework combining a physiologically-based pharmacokinetic (PBPK) and Krogh Cylinder tissue model to predict both the systemic and tumoral distribution of antibodies. Finally, applying these experimental and computational techniques, we improve the tumor penetration and efficacy of a clinically approved antibody-drug conjugate, demonstrating that distribution plays a major role in efficacy and can be manipulated to develop more effective therapeutics.

Elizabeth Cliff
Health Services Organization and Policy

Changing Incentives and Information: How Demand-Side Strategies Affect Utilization and Price

Levels and growth of health care spending in the United States are among the highest in the developed world, raising concerns about both national expenditures and affordability for individuals. Health insurance plans share medical service costs with enrollees to encourage efficient health care use and control spending. Yet, we lack robust knowledge of the effects of recent innovations in plan cost-sharing structures. This dissertation examines the effect of two common plan structures on components of health spending: medical prices and service use. I quantitatively analyze large datasets with multiple years of medical insurance claims to measure use of and prices for medical services after switching to a plan with a new cost-sharing structure. The goal of this research is to advance understanding of how cost sharing impacts health spending and inform optimal design of health insurance plans.

Sheila Coursey
English Language and Literature

Criminal Theatrics: Crime, Community and Audience Engagement in Tudor Drama

My dissertation examines audience engagement in Tudor drama, specifically the contractual relationships between audience and stage that are activated or made visible through narratives of crime. I explore narratives of crime and disorder within a variety of late medieval and early modern theatrical genres, including biblical drama, morality plays, and domestic tragedy. My focus is not on the performance of criminal acts themselves, but rather on the resulting communities that emerge onstage: civilian groups who work to prevent, solve, or avoid crime. These groups, comprised of minor characters or a theatrical chorus, serve as gateways for the audience, modeling reactions or directly soliciting response. These onstage communities and their criminally-adjacent work also challenge the audience to reflect on their own participation within the theater— the negotiations of consent, surveillance, and complicity that govern theatrical spectatorship. My dissertation demonstrates that the interplay between these onstage communities and the audience creates new possibilities for theorizing early audience engagement and response.

Jesse Crosson
Political Science

Waiting to Win, Choosing to Lose: How Electoral Uncertainty Stymies Policy Change

How does electoral competition over majority control influence Congress's ability to draft and pass meaningful legislation? Today, even the most casual observers of U.S. politics understand legislative gridlock to be a key feature of the modern U.S. Congress. Since at least the 1990s, scholars, media pundits, and even politicians have called attention to Congress's lack of productivity, most often attributing the phenomenon to growing ideological polarization between the U.S.'s two major political parties. But while the widening gulf between Republicans and Democrats—and the influence it likely has on policy change and legislative gridlock—is undeniable, I argue in this project that most accounts of legislative gridlock have ignored a crucial factor that has also changed dramatically since the mid-1990s: the rise in competition over majority control of Congress. Indeed, while Democrats dominated Congress for much of the 20th Century, neither party today enjoys such dominance: no matter who holds the majority, the out-party represents a credible threat to overtake the current majority in the upcoming election. This project develops a new theory of policy change that articulates and tests the conditions under which this sort of electoral competition encourages or stymies policy change, beyond what polarization alone might predict. Ultimately, the project would provide an explanation for why even popular legislation often fails to gain traction—and why polarization does not itself always predict a Congress's levels of productivity. Tying legislative productivity to electoral competition in this way would also carry with it potential normative, constitutional, and policy implications regarding topics such as the frequency of elections and the appropriateness of partisan agenda-setting in Congress.

Adam Crowe
Chemistry

Synthesis and Electrochemical Characterization of Electrolytes for Magnesium-Ion Batteries

Magnesium as an emerging battery technology is desirable because the element is abundant and inexpensive. However, magnesium chemistry is challenging because transporting the divalent cation is slow, and the overpotential for depositing and stripping the metal is large. This dissertation work develops the design principles for generating magnesium electrolytes with high ionic conductivity, a large electrochemical stability window, and low overpotential for transferring electrons. The most promising candidate discovered to date is the salt formed from reacting a fluorinated tert-butoxide magnesium chloride with aluminum chloride that shows Li-ion battery-like anodic stability and solution conductivity (3.2 V vs. Mg2+/0 and 3.5 mS/cm, respectively) with less than 400 mV overpotential for Mg deposition. Current work focuses on measuring the kinetics of charge transfer at the electrode/electrolyte interface of varying technologically relevant electrodes.

Longji Cui
Mechanical Engineering

Probing energy transport, conversion, and dissipation at the atomic and molecular scale

The study of energy transport and conversion at the nanoscale is of fundamental interest and holds great promise to improve numerous technologies including nanoelectronics, thermoelectrics, and photovoltaics. Although much attention has been directed towards nanoscale optics and electronics, thermal properties at the atomic and molecular scale have been barely explored due to experimental challenges. To tackle these challenges, a series of techniques are developed to answer long-standing questions including how heat is conducted through atomic-contacts and single-molecules, radiated across nanogaps, and converted to electricity in molecular junctions. Specifically, by employing scanning thermal probes, quantized thermal transport in single-atom junctions is observed. Moreover, thermal radiation in angstrom scale gaps is examined and results in heat fluxes several orders of magnitude larger than Planck's Blackbody limit. Finally, molecular-scale refrigeration is demonstrated. These findings set the stage for rational design of thermally-efficient nanodevices and are expected to enable development of sustainable energy technologies.

Sunan Cui
Applied Physics

Deep Learning Techniques for Radiotherapy Outcome Modeling

Predicting treatment outcomes is critical to prescription personalization and response optimization in radiotherapy. Nowadays, the application of traditional machine learning models based on patient-specific information (e.g., biological, dosimetric, and clinical variables) have been expanding. However, these models are not efficient in representation, particularly when dealing with heterogeneous, sparse clinical datasets. Hence, application of deep learning has been investigated to overcome these barriers. First, multi-layer neural perceptron (MLP) was applied to predict outcomes. Then, a composite architecture of 1D convolutional layers and MLP was designed to take advantage of correlations among longitudinal data. To avoid handcrafting of features and fully realize the potential of deep learning in this field, counterparts of "transfer learning" are to be found. Alternatively, we are developing novel approaches to augment data and generate meaningful multi-dimensional maps from unstructured patient-specific variables so that "transfer learning" can be realized. This involves the application of different multivariate statistical signal processing techniques.

James Day
Biomedical Engineering

Immuno-isolating Synthetic Hydrogel System Supports Ovarian Tissue Survival to Promote Restoration of Reproductive Endocrine Function

A common irreversible adverse effect of life-saving anticancer treatments is loss of gonadal endocrine function and fertility, calling for a need to focus on post-treatment quality of life. The current treatment for pre-pubescent girls includes auto-transplantation of ovarian tissue, however this presents the risk of re-introducing malignant cells. For this reason, we developed immunoisolating poly(ethylene glycol) capsules to support donor ovarian tissue for restoration of endocrine function in mice. When encapsulated in non-degradable, degradable, and a dual PEG capsule with a degradable core and non-degradable shell, we demonstrate ovarian tissue survives and develops when implanted in ovariectomized mice, restoring the hypothalamic-pituitary-gonadal axis. In an allogeneic mouse model, we demonstrate allogeneic tissue encapsulated in the dual PEG capsule is not rejected by the host, indicating the dual PEG capsule is immunoisolating. Encapsulation in the dual capsule allows the ovarian tissue to remain functional and restore endocrine function without risk of rejection.

Xinqiang Ding
Bioinformatics

Advances in physics and probabilistic based computational methods for modeling in drug discovery and protein engineering

Developing a new drug takes several years and costs billions of dollars. Computational methods for drug discovery, such as protein-ligand docking and free energy calculations, are essential to reduce both time and financial cost. In the dissertation, we have developed an accelerated protein-ligand docking method called FFT-CDOCKERGPU and a new free energy method called Gibbs Sampler Lambda Dynamics (GSLD). These two new methods result from combining concepts and methods from computer science, statistics, and computational chemistry. Moreover, in the dissertation, we also developed a novel application of probabilistic generative machine learning models for protein engineering. These models are shown to be useful in the prediction of protein contact maps, from which one can infer protein structure, protein stability changes upon mutation, and evolutionary relationships between sequences. Thus, the application of such models is useful in guiding protein engineering efforts.

Jaclyn Durkin
Neuroscience

The role of state-dependent thalamocortical communication in visual system plasticity

Sleep is a phylogenetically conserved state of unconsciousness which appears to play a major role in learning and associated changes in the strength of synapses between neurons. However, the mechanism through which sleep contributes to these fundamental brain functions remains a mystery. During non-Rapid Eye Movement (non-REM) sleep, coordinated firing of neurons in thalamocortical circuits generate brain rhythms characteristic of this sleep stage. These rhythms have been correlated with learning in a number of animal models. My dissertation examines the role of this sleep-specific thalamocortical activity in mediating changes within mouse visual circuitry following visual experience. Using optogenetics and in vivo electrophysiology, I have recently found that non-REM rhythms in this circuit are necessary for expression of cortical plasticity. My current studies are aimed at further clarifying the role of thalamic neurons in this process, by optogenetically inhibiting neurons in the visual thalamus in a state-dependent manner.

Arthur Endsley
Natural Resources and Environment

Understanding the biophysical consequences of neighborhood socio-economic change

The spatial arrangement and timing of urban land-cover changes—pavements or vegetation cover—can serve as indicators of human activities: land is cleared for new housing or retail, existing vegetation cover matures, and some areas are abandoned or redeveloped. By observing these changes, can we draw inferences about changing patterns of wealth, public and private investment, and residential occupancy? Through a comparative analysis of three U.S. cities, I will determine the land-cover change trends associated with different neighborhood trajectories and model the effects of neighborhood socio-economic change on vegetation change. To this end, I am applying statistical learning and multi-level models to 30-year records from satellite remote sensing and real estate inventories. With the aim of improving our understanding of the biophysical consequences of neighborhood change, this work has implications for demographers, urban planners, and models of urban ecosystem change.

Calder Fong
Germanic Languages and Literatures

Bergbau, Tagebau, Umbau: A Cultural History of Design, Landscape Architecture, and Memory in the Remediation of Former Mining Sites in Germany

The redesign of decommissioned German coal mines in the 1990s, through which abandoned mine shafts, mountains of mining refuse, and desert-like strip mines turned into verdant post-industrial landscapes, is the subject of my dissertation, "Bergbau, Tagebau, Umbau: A Cultural History of Design, Landscape Architecture, and Memory in the Remediation of Former Mining Sites in Germany." I examine walking tours through mines, architectural landmarks, land art installations, public parks, and exhibitions that arose under two programs that took place between 1989 and 1999 on opposite sides of the former German-German border. These programs collaborated to combat environmental, social, and economic impacts of deindustrialization through creative reuse and musealization. Through my analysis, I identify the design principles and cultural values that constitute a German "post-industrial landscape aesthetic" that resolves contradictions between the creation of opportunities for lighthearted amusement and the memorialization of the past, and between environmental conservation and industrial heritage preservation.

Amy Fraley
Medicinal Chemistry

Structure and function of MalA, an iterative halogenase for late stage C–H functionalization

Malbrancheamide is a natural product with biological activity as a calmodulin antagonist and vasorelaxant. The two chlorine atoms on the indole ring of the molecule significantly contribute to this activity, but the challenges associated with the synthetic methods for preparing halogenated natural products precludes synthesizing these molecules for further testing as potential therapeutics. In this study, we characterized MalA halogenase which is involved in the biosynthetic halogenation of malbrancheamide. Structural analysis and computational studies of MalA provided insights into a potentially unique reaction mechanism. With this knowledge base, we have engineered the protein to be site-selective, while also generating biocatalysts for environmentally benign halogenation reactions. Using MalA, a library of halogenated malbrancheamide analogs has been generated, and will be tested for biological activity in systems implicated in cardiovascular disease.

Arianna Gard
Psychology

Environmental, Genetic, and Neural Contributions to Adolescent Internalizing Symptoms

Nearly 40% of U.S. youth aged 13 to 18 experience clinically-significant levels of anxiety (Merikangas et al., 2010) and 10% percent report at least one major depressive episode annually (Center for Behavioral Health Statistics and Quality, 2015). Internalizing disorders such as anxiety and depression are associated with substance use, academic problems, and social impairments (Thapar, Collishaw, Pine, & Thapar, 2012), making the prevalence of these disorders a serious public health concern. Internalizing disorders emerge in adolescence from a combination of environmental, genetic, and neural risk factors. This dissertation integrates these lines of research in three papers using a nationally representative, ethnically-diverse birth cohort of 4,898 adolescents and their families followed from birth through age 15. Using observed measures of parental warmth and harshness at ages 3, 5, and 9, paper one constructs trajectories of parenting across childhood (N = 3,162) and examines the effects of these trajectories on neural function at age 15 using fMRI (N = 167). Using genome-wide genetic data (N = 2,884), paper two explores the structure of genetic effects on internalizing symptoms using polygenic risk scores for anxiety disorders, neuroticism, and depressive symptoms. Paper three uses these genome-wide polygenic risk scores for internalizing outcomes to probe the role of genetics in parenting-brain-internalizing pathways. Drawing upon neurogenetics theory, this dissertation hypothesizes that parenting trajectories characterized by high harshness and low warmth in early childhood predict internalizing symptoms via changes in neural regions that underlie emotion processing. However, only youth with high genetic risk for internalizing will develop poor outcomes when exposed to high harshness and low warmth.

Katherine Gentry
Biophysics

Chemical and Structural Modulations of Cytochrome P450 Interactions with Redox Partners

Cytochrome P450s (cytP450s) are a ubiquitous super family of enzymes that are responsible for the metabolism of many substrates, including over 70% of the drugs on the market. Two electrons are required to complete cytP450's catalytic cycle which are donated by its two redox partners: cytochrome P450 reductase and cytochrome b5. Understanding the interplay of the three proteins is of high interest to capture how substrates are metabolized. Previous studies have only scratched the surface of how this complex works together. To fully investigate this complex interplay, we need to utilize full-length proteins, membrane mimetics, and substrates. In my thesis, I use NMR spectroscopy and other biophysical techniques to probe the structure and dynamics of the redox partner interactions with cytP450. This work characterizes the structural interactions, dynamics, and functional details of these important protein-protein interactions.

Amin Ghadami
Mechanical Engineering

Anticipating Bifurcations for Identifying Dynamic Characteristics of Complex Systems

Dramatic changes occur in the dynamics of complex systems, from ecosystems to engineered systems. Forecasting such events is of major importance and would have a significant impact in a variety of fields. In this research, a model-less approach is introduced to forecast critical points and post-critical dynamics of complex systems using measurements of the system response collected only in the pre-transition regime. The method is employed to forecast 1) flutter instability in fluid-structural systems, and 2) collapse of natural populations in ecological systems, as two important classes of complex systems. Our theoretical and experimental results highlight that by monitoring the system's response to perturbations in the pre-transition regime, it is possible to forecast bifurcation diagrams and gain crucial information about the future system's safety and stability, such as distance to upcoming transition and future system equilibriums, which makes our method a unique tool for stability analysis of complex systems.

Tamy Guberek
Information

Truth-Telling and Data Dilemmas: The Science and Politics of Communicating Uncertainty in Human Rights Data

Political violence and human rights abuses are hard to observe. Existing datasets of these events contain absences that, in the aggregate, can amplify racial and socio-economic bias in criminal justice contexts, undermine credibility of human rights organizations, and privilege certain historical narratives about patterns of abuses. But how does communicating data uncertainty impact decision-making? While human rights scholars recommend that data providers transparently communicate data limitations to data consumers, the literature from cognitive science and science communication disagree on whether expressing data uncertainty is effective, neutral or unproductive. In fact, there is little empirical understanding of how presenting data uncertainty is received across politicized human rights information environments, and how it interacts with cognitive biases. This dissertation uses experimental and qualitative methods to explore the impact of conveying data uncertainty to decision-makers. The study's findings will have wide-reaching impact on the fields of human rights, science communication, and evidence-based decision-making.

Marios Hadjiantonis
Physics

Aspects of symmetries in effective field theories

Effective field theories (EFTs) are used extensively in particle physics for precision calculations at large length scales. In this work, we examine how symmetries of the underlying system constrain such theories by utilizing non-traditional methods from the scattering amplitudes program. We specifically address EFTs with partially spontaneously broken supersymmetry. We find a surprising connection between these and EFTs of spontaneously broken space-time symmetries. Motivated by this, we further explore how different broken and/or unbroken symmetries interact with each other in effective theories.

I-Uen Hsu
Molecular, Cellular, and Developmental Biology

Analysis of the Dstac Gene, a Novel Neuronal Regulator of Neuronal Function and Behavior in Drosophila melanogaster

The stac genes encode a family of adaptor-like proteins with conserved functional domains across species. stac1 and stac2 are expressed by subsets of neurons, and stac3 is expressed by skeletal muscles in vertebrates. The Kuwada lab identified Stac3 as a key regulator of excitation-contraction coupling during which Stac3 regulates the L-type voltage-gated calcium channel that is necessary for muscle contraction. The function of neural stac genes, however, is completely unknown. We identified the stac gene in Drosophila melanogaster and found that Dstac is expressed both by muscles and by specific classes of neurons. Dstac is expressed in neurons that express pigment dispersing factor and is required for normal circadian activity. Dstac is also expressed by a subset of motor neurons that is necessary for normal locomotion. Our work defines the first function for the stac genes in neurons by showing that Dstac is a novel neuronal regulator of behaviors.

Daning Huang
Aerospace Engineering

Development of a Hypersonic Aerothermoelastic Framework and Its Application to Flutter and Aerothermoelastic Scaling of Skin Panels

Airbreathing hypersonic flight, i.e., flying five times faster than the speed of sound in the atmosphere, has the potential to revolutionize the global transportation and has been one of the last frontiers in the aerospace industry for over seven decades. Unlike conventional commercial aircraft, airbreathing hypersonic vehicles are naturally interdisciplinary: the aerodynamic, structural, and thermal responses are tightly coupled. Sustained hypersonic flight causes severe aerodynamic heating and leads to strong thermal stress and material degradation in the vehicle, which can compromise the structural stability and cause catastrophic failures. This dissertation presents the development of a computational framework for efficient and accurate aerothermoelastic simulation over extended flight time. On top of the framework, a novel approach is presented to achieve aerothermoelastic scaling laws that enables the extrapolation of experimental data obtained on scaled models to full-size vehicles, resulting in a potentially dramatic cost reduction in the hypersonic vehicle design cycle.

Trevor Hyde
Mathematics

Polynomial factorization statistics and dynamical Mordell-Lang theorems

In this thesis I present new results on arithmetic statistics and arithmetic dynamics at the interface of combinatorics, representation theory, and theoretical computer science.

Valentina O. Igenegbai
Chemical Engineering

Development of solid oxide membrane reactors for direct upgrading of natural gas to value-added chemicals

In the United States and around the world, natural gas from small-scale sources is commonly flared into the atmosphere due to the unavailability of a commercially viable means of utilization. This flaring does not only lead to the waste of a valuable resource, but also the emission of greenhouse gases. In my dissertation work, I am developing novel solid oxide membrane reactors that are potentially applicable in the direct upgrading of natural gas from small-scale sources into value-added chemicals; thereby mitigating their underutilization and flaring. First, I analyze a promising direct natural gas upgrading technology (i.e., the oxidative coupling of methane) and demonstrate that the application of a solid oxide membrane reactor can, in principle, result in higher yield of value-added products compared to a conventional reactor. Next, I experimentally investigate new membrane reactor systems with a goal of demonstrating their improved performance in this natural gas upgrading technology.

Annie Jeng
Piano Performance and Pedagogy

Circles and Lines: Understanding Unconventional Piano Techniques at the Early Stages of Piano Studies

With each innovation of the piano since 1700, composers have pushed the boundaries of what the instrument is capable of, resulting in a vast repertoire often utilizing unconventional techniques and notation systems. Much of this recent repertoire, however, is written by male composers, specifically for advanced pianists. Young pianists are not exposed to these types of techniques, sounds, and concepts during the foundational years of their musical development. As time passes and advanced repertoire continues to grow, our pedagogical resources lose relevance. Circles and Lines attempts to address this schism in the early formative years of a student's development. It is a progressive method book, with new and engaging repertoire for both upright and grand pianos, written by female composers from diverse backgrounds. Each piece is specifically commissioned to include non-traditional techniques, allowing the associated sounds and concepts to be fully integrated into students' musical lives from the earliest ages.

Hezao Ke
Linguistics

Feature retrieval in the processing of grammatical illusions

The cue-based retrieval model faces theoretical and empirical questions because, on the one hand, it is not able to encode long-distance syntactic relations such as c-command; on the other hand, it fails to predict the processing differences in grammatical illusions between subject-verb agreement and reflexive binding. To address these questions, this thesis develops a new computational model by modifying two core components of the cue-based retrieval model. First, I propose an algorithm that encodes c-command and locality as features on the c-commandees, which can then serve as retrieving cues for memory retrieval. Furthermore, I propose a theory of cue-based retrieval based on an independently motivated Minimalist (feature interpretability) distinctions, which has been largely ignored in previous studies. Then I construct three possible distinctive models, examining their predictions using computational modeling. Finally, the validity of these three theories is finally tested in an eye-tracking and an ERP experiment.

Kayti Lausch
Screen Arts and Cultures

To Evangelize and Entertain: A Cultural and Industrial History of Religious Television in the United States

In the last six decades, religious television networks have emerged as a powerful cultural and political force in the United States. Using archival research as well as period discourse (including national and local newspapers, magazines, books, and trade journals), this dissertation charts the histories of three networks (the Christian Broadcasting Network, the Trinity Broadcasting Network, and the American Christian Television System) and how they built alternative spaces for their viewers from 1961 to the present. This dissertation addresses the role that religious television networks played in the emergence of the Religious Right, the ongoing culture wars, and the rapid growth of the television industry. I argue that religious television networks have played a crucial role in shaping American political discourse and culture by successfully creating and nurturing a new demographic of television viewers encouraged to define themselves as counter to the mainstream because of their religious and moral values.

Zhengda Li
Bioinformatics

Investigate the Design Principles of Biological Oscillators

A variety of biological systems, including circadian clock, heartbeat, and cell cycle, display rhythmic oscillations. Early genetic studies have mapped out the underlying molecular networks for these biological oscillators. The central architectures of the oscillators are highly conserved. This suggests that network structure is a key factor in determining the oscillation properties. In my graduate study, I have been investigating the design principles of biological oscillators. I systematically analyzed the topology of biological oscillators, and identified novel network structures that affect robustness and tunability, both are key properties of oscillator functions. To further study these structures experimentally, I am using high-throughput mitotic droplet system that is amenable to precise control of various experimental conditions. This work provides valuable insights into the mechanisms to fine-tune biological oscillators, and may inspire new understanding of diseases such as insomnia and cancers that tend to be caused by deficiencies in biological oscillators.

Eli Lichtenstein
Philosophy

Form and Force: An Inhumanist Philosophy of Power for Modern Scientific Culture

I develop an original successor to Nietzsche's theory of will to power. I emphasize power itself, including self-amplifying vital but also purely inorganic force. My account centers around arational force and natural form, or impact and extension understood as interdependent aspects of power. I critique rationalistic conceptions of aesthetic form, arguing that beauty is the sensuous appearance of 'dynamic form' and sublimity is the overwhelming sensory impact of 'mastering force.' I examine historical connections between the newfound prominence of laws of nature in the 17th-century and notions of (divine or monarchical) dominion, which I work to de-anthropomorphize. I argue that law-governed explanation and scientific systematicity—encompassing desiderata like simplicity, breadth of scope, consistency, clarity, and precision—are valuable as formal manifestations of power. Finally, in dialog with Heidegger and Jünger, I argue that objective representation involves human mastery over nature, but insist this reflects our own cognitive determination by superior natural force.

Boang Liu
Statistics

Statistical analysis of network-structured data

Networks are common in many fields, capturing connectivity relationships between individuals. The current version of the dissertation addresses two fundamental problems in network analysis. The first problem is community detection. Most existing community detection methods use network structure alone while ignoring node covariates. We develop a statistical framework to model relationships between the network, node covariates and communities, and propose two models from the most general families. Further we establish identifiability conditions and develop efficient algorithms for model estimation. The second problem is to classify network nodes using both node covariates and network structure. Again, we develop a general statistical framework and establish consistency properties for plug-in classifiers with respect to the optimal Bayes classifiers under two general families of distributions. We also apply the proposed approaches to specific models and propose effective methods for practical use. In the future, I plan to incorporate edge covariates for statistical network analysis.

Tom Logan
Industrial and Operations Engineering

Integrating Risk Analysis and Urban Planning: Preparing Our Communities for Uncertain Futures

The damage Hurricane Harvey wrought on Houston should not become commonplace. This damage, and ofttimes damage from other natural events, is severely exacerbated by inadequate conceptualization and integration of risk into urban planning. We must address this knowledge gap and ultimately improve the resilience of our cities to climate change. I present a fundamentally new way of conceptualizing risk for climate adaptation planning. My dissertation addresses how we understand and model risk evolution; how we plan for uncertainty that is so vast that both the direction and magnitude of change is debated; and how we integrate the risk and uncertainty of natural events in a way that is plausible to decision makers. I explicitly model urban regions with synthetic natural hazards to develop a risk-based decision-making framework incorporating uncertainty. My research provides actionable information with which cities, such as Houston, can evaluate planning alternatives in preparation for future climate conditions.

Jacob Ludwig
Chemistry

Catalytic Carbonyl-Olefin Metathesis

Olefin metathesis is an indispensable transformation for organic chemistry that has led to extraordinary innovations in the petroleum, materials, agricultural, and pharmaceutical industries. Characteristics that contribute to its importance include: the use of highly active, discrete metal catalysts that function through a thoroughly-characterized mechanism, an operationally simple protocol that often produces an inert, easily removable olefin byproduct and a broad scope that uniquely allows for the synthesis of many important molecules or materials. The corresponding carbonyl-olefin metathesis reaction has the potential to exhibit the same beneficial characteristics, however, the most commonly used methods suffer from harsh reaction conditions or the need for stoichiometric transition metal reagents. Herein, we report the first general, catalytic carbonyl-olefin metathesis reaction that relies on iron as a readily-available, environmentally benign catalyst. Subsequent efforts are directed towards related carbocyclization reactions and strategies for expanding the scope of carbonyl-olefin metathesis.

Kurt Lundeen
Civil Engineering

Localization, Mobility, Perception, and Manipulation for Mobile Construction Robots

Civilization is dependent upon built environments, such as buildings, roads, and utilities, but built environments are time consuming and dangerous to construct. Robots can help us construct our environments at a lower cost, in a shorter timeframe, with higher quality, and with improved safety, but technological challenges have thus far prevented such possibilities from becoming reality. This research seeks to address the fundamental challenges hindering robots from becoming useful construction coworkers. Unlike manufacturing robots, whose kinematics are pre-programmed based on robust metrology, tight tolerances, and rigid workpieces, construction robots operate under conditions of imperfect metrology, loose tolerances, and large workpiece uncertainties. As such, construction robots must perceive their environments and act accordingly. Namely, this research seeks to address fundamental challenges associated with robot localization, mobility, perception, and manipulation by providing the novel sensor systems, robotic platforms, and adaptive framework necessary for robots to function in unstructured environments like construction sites.

Xinwei Ma
Economics

Essays on Non-/Semi-parametric Methods in Economics

Non-/semi-parametric methods are widely used in empirical studies in economics, to avoid imposing stringent and unrealistic functional form assumptions. The proposed dissertation consists of three chapters on important issues in conducting causal inference and forming robust estimates of key economic parameters. In an important class of two-step models, the first chapter provides estimation and inference procedures that are robust to including high-dimensional covariates. Robustness is achieved by the jackknife bias correction and the bootstrap is employed for statistical inference. The second chapter develops a non-parametric estimator of probability density function based on local polynomials. The proposed estimator is easy-to-implement and is robust to discontinuities in the underlying density, an important concern in empirical research. The third chapter discusses identification issues in bunching designs, a framework for elasticity estimation using distributional mass points. The local polynomial-based density estimator will be applied for estimation and inference, providing strict improvement over current practice.

Anna MacCourt
Anthropology and History

Lord of the Universe ... Among Equals: The Challenges of Kingship in the Maitraka Era

My dissertation examines the development and implementation of ideals of kingship in mid-first millennium CE India, through a focus on the Maitraka dynasty of Gujarat. These ideals were highly contested, as religious elites and kings alike made efforts to frame the royal sphere. The centuries old conflict between Brahmanical and Buddhist orders ultimately produced many of the foundational works of Sanskrit political philosophy. For their part, kings selectively participated in and creatively manipulated these cosmological ideals. My dissertation brings these expansive debates down to the ground, by examining how a single dynasty worked in and through these highly contested models. Rather than assume that political universals of the current social theory, such as legitimacy and sovereignty, apply to the politics of ancient India, I build a view of politics from royal practices, crossing disciplinary boundaries and incorporating literary and courtly sources with religious literature, inscriptional evidence, and archaeological findings.

Kelly Matsunaga
Earth and Environmental Sciences

Fossils, fruits, and phylogeny: an integrative approach to understanding the historical biogeography of the palm family (Arecaceae) over the last 100 million years

The palms are a widespread family of tropical flowering plants with a long and rich fossil record spanning the last ~90 million years of Earth history. My dissertation uses data from living and fossil species to test hypotheses on the evolutionary and geographic radiation of palms, and elucidate underlying mechanisms. Chapter one investigates fossil palms of Late Cretaceous of India and the role of India in the palm radiation. In chapters two and three I generate a time-calibrated phylogeny of palms that includes fossils, and use this phylogeny in model-based analyses of historical biogeography. Finally, for chapter four I analyze changes in dispersal and local extinction over the Cenozoic to understand the effects of climatic shifts on palms through time. This adds to our knowledge of palm evolution and biogeography, and demonstrates the utility of fossils in these widely used analyses.

Filipa Melo Lopes
Philosophy

Recognizing Social Subjects: Gender, Disability, and Social Standing

In this project, I investigate the role of gender in our social lives and its importance for feminist politics. I start from the inchoate but often cited intuition that gender seems to be 'everywhere' and to matter to us a great deal. I argue that this is because gender legibility is tied to what I call social standing: to our very ability to enter social relations. The notion of social standing elucidates what is at stake in gender, but also draws important connections between various forms of marginalization. I argue that it does so most clearly between gender and certain forms of visible disability. I go on to show that this social theoretical framework sheds light on the recalcitrance of gender oppression, particularly by illuminating recent and puzzling backlash phenomena. It therefore opens up new ways to think about challenging patriarchal systems effectively.

Nicole Michmerhuizen
Pharmacology

Small Molecule Profiling Uncovers the Landscape of Combinatorial PI3K Inhibitor Responses in Head and Neck Squamous Cell Carcinoma

Recent sequencing studies of head and neck squamous cell carcinomas (HNSCCs) have identified the phosphatidylinositol 3-kinase (PI3K) pathway as the most frequently mutated, oncogenic pathway in this cancer type. Despite frequent alteration in PI3K pathway genes, targeted inhibitors of PI3K have shown limited clinical efficacy as monotherapies. To identify factors that might predict sensitivity and resistance to PI3K inhibitors (PI3Kis), we tested a panel of more than 25 patient-derived HNSCC cell lines to determine PI3Ki responses and sought to correlate drug sensitivities with genetic or phenotypic features. We also developed and optimized a small molecule profiling approach to characterize potential mechanisms of PI3K inhibitor resistance in HNSCC. We have used our profiling assay to test ~1400 inhibitors as monotherapies and in combination with PI3Kis in ten HNSCC models. Our approach identified both known and novel synergistic drug pairs, which we examined further using in vitro and in vivo experiments.

Dylan Mitchell
Chemical Biology

Development of a chemoproteomic pipeline for site-specific kinase identification

Recent estimates of the human proteome suggest that there are ~20,000 protein-coding genes, the protein products of which contain >145,000 phosphorylation sites. Unfortunately, in-depth examination of the human phosphoproteome has far outpaced the ability to annotate the kinases that mediate these post-translational modifications. To obtain actionable information about phosphorylation-driven signaling cascades, it is essential to identify the kinases responsible for phosphorylating sites that differ across disease states. To fill in these knowledge gaps, my dissertation describes the development and implementation of an unbiased, chemoproteomic approach for identifying high confidence kinase-substrate interactions with phosphosite specificity. Using this assay, I have uncovered the role of cyclin-dependent kinase 4 (CDK4), a clinically validated kinase important for cell cycle progression, in driving cap-dependent translation via phosphorylation of the tumor suppressor 4E-BP1. The discovery of this novel signaling axis sheds new light on the mechanisms by which CDK4/6 inhibitors control cell proliferation and constitutes the first example of successful kinase discovery using an activity-based, kinase-directed probe.

Stephen Molldrem
American Culture

Making Sex Real: Materializing Sexualities Through HIV Work, LGBTQ Health, and Health Information Technology in the United States and Atlanta

My dissertation offers an empirical framework for describing how sexual knowledge is produced and utilized in contemporary healthcare. Data come from extensive health policy research and ethnography with practitioners in HIV/AIDS, LGBTQ health, and health information technology (IT). Recent developments in U.S. health IT have transformed how health data are used to understand sexuality. However, sexuality studies cannot currently account for how actionable biomedical knowledge about sex is created. I therefore draw upon constructivist science and technology studies (STS) to detail the exact mechanisms by which actors in healthcare continually employ technologies and epistemic frameworks to sustain localized conditions for apprehending sexuality, or what I call "situated sexual realities." I develop a grammar that captures how sexual identity categories such as "homosexuality" can be stable across contexts, while also accounting for how actionable knowledge about sex is radically contingent upon the techniques used to measure it in particular organizations.

Annareli Morales
Climate and Space Science and Engineering

Orographic Precipitation Sensitivity to Microphysical, Environmental, and Mountain Geometry Parameter Perturbations

Orographic precipitation plays a vital role in providing water resources to mountain communities. The precipitation type, amount, and location is determined through complex interactions between cloud microphysics, environmental conditions, and the mountain height and width. This dissertation performs idealized numerical simulations of quasi-2D flow representative of an atmospheric river over a bell-shaped mountain, where the microphysical, environmental, and mountain shape controls on surface precipitation and cloud development are explored. The quantitative sensitivity of precipitation to changes in these parameters is assessed with the Morris screening method, a robust statistical tool allowing for simultaneous perturbation of numerous parameters, applied for the first time to orographic precipitation sensitivity studies. In addition, this research extends past work utilizing a Markov chain Monte Carlo algorithm by including ice microphysical processes. Results from this dissertation will help enhance knowledge of dominant precipitation controls and help forecasters better predict orographic precipitation through improved ensemble forecasts.

Takumi Murayama
Mathematics

Characterizations of projective space and embeddings into projective spaces

We study the geometry of algebraic varieties, which are geometric spaces defined by polynomials. The most simple of these spaces is projective plane, where two lines always intersect; these form the mathematical basis of the theory of perspective (in the artistic sense). We focus on two questions about the projective plane, and its higher-dimensional analogues, projective space. First, how can one characterize when a given variety is a projective space? Second, even when a variety is not a projective space, can it be embedded into a projective space, and how nicely embedded will it be? We approach both questions by studying the tangent bundle, which is a geometric object parametrizing all tangent spaces of a variety. These bundles allow us to identify special curves inside a variety, which is key to understanding the answer to both questions.

Prash Naidu
Anthropology

Sea-change: Mambai Sensory Practices and Hydrocarbon Exploitation in Timor-Leste

How do people sense socioeconomic and atmospheric transformations? 'Sea-change' examines sensory practices of Mambai cultural groups undergoing conditions of hydrocarbon extraction, land appropriation, and environmental degradation in southwest Timor-Leste. Drawing from long-term ethnographic research, it explores Mambai notions of embodied ethics—how sensory processes, in particular olfaction, sound, and proprioception, play a substantial role in the formation of cultural and ethical subjects. By focusing on patterned, embodied modes of being, I ultimately argue that sensory practices illuminate moral experience and action. Through multi-modal research methods including participatory smell diaries, and olfactory and sonic pollution mapping, this research also contributes to studies on how humans negotiate sensory pollution. Whereas existing scholarship has documented the external ordering of human lives, 'Sea-change' aims to surpass neat narratives of domination of one group over the other and takes into account how humans articulate their sensory practices in response to novel political and economic systems.

Samir Nath
Cellular and Molecular Biology

Defining and Characterizing Novel Therapeutic Targets in Spinobulbar Muscular Atrophy

Polyglutamine (polyQ) diseases encompass nine fatal neurodegenerative disorders. One of these is spinobulbar muscular atrophy (SBMA), a progressive disease of skeletal muscle and motor neurons. As muscle is a critical target tissue, my thesis seeks to understand mechanisms of muscle toxicity. I demonstrate for the first time impairment of the ubiquitin-proteasome pathway in SBMA mice. These changes are age and hormone dependent, tightly mimicking the patient phenotype, and result in progressive impairment of protein quality control. As toxicity from the disease-causing protein triggers these changes, I studied mechanisms to remove the mutant protein. I discovered that a post-translational modification called neddylation plays a critical role in its clearance. Excitingly, inhibition of neddylation with a small molecule drives clearance of polyQ AR in SBMA cell and mouse models. These findings identify untapped therapeutic targets in a disease with no treatment options.

Annemarie Navar-Gill
Communication Studies

Knowing the Audience in the Information Age: Big Data and Social Media in the U.S. Television Industry

The television industry is organized around its ability to gain information about its audiences (Johnson 2014). Historically, this knowledge took the limited forms of ratings and audience research (Ang 1991, Gitlin 1983). In the digital era, new technologies offer more exhaustive and naturalistic ways to capture audience behavior. This project documents how the industry is using these technologies to negotiate its place in contemporary algorithmic culture. Drawing on eight months of fieldwork in Los Angeles and New York, I show how the abundance of new information about audiences—ranging in scale from population-level "big data" behavior tracking to individual encounters with fans on social media—is made sense differently across industry sectors, influencing business decisions, storytelling conventions, and promotional practices. Since an "audience" is constituted by the technologies used to apprehend it, I ultimately argue our contemporary digital context necessitates a reconceptualization of this key term in media studies.

Kari Neier
Toxicology

Metabolic Re-Programming from Developmental Exposures to Phthalates: Utilizing a Mouse Model to Understand Molecular Mechanisms and Inform Human Studies

Obesity and its comorbidities, including type II diabetes and heart disease are some of the top preventable threats to public health. Mounting evidence suggests that exposure to environmental chemicals influences obesity risk. Developmental exposures to phthalates, chemicals found ubiquitously in our environment, have been linked to obesity and metabolic syndrome. However, mechanisms are poorly understood. An additional challenge is that humans are exposed to mixtures of many different phthalates, and metabolic effects arising from phthalate mixtures are difficult to characterize in human epidemiological studies. This research utilizes a longitudinal mouse model of developmental exposure to phthalates and phthalate mixtures to evaluate metabolic health effects across the life course. Changes in gene expression and epigenetic modifications will be measured in metabolic tissues to explore mechanisms of metabolic re-programming. Findings from this work will be used to inform current and future epidemiological studies and to provide a basis for further mechanistic studies.

Andrew Nelson
Pharmacology

The Role of Ankyrin-G in Cortical Circuitry

The ANK3 gene, which encodes the ankyrin-G protein, is one of the most significant genes associated with bipolar disorder. Ankyrin-G stabilizes GABAergic inhibitory synapses, which are essential for the proper synchronization and function of brain networks. Abnormalities in GABAergic circuitry have been linked to bipolar disorder; however, the underlying pathophysiological mechanisms remain poorly understood. The focus of this dissertation is to elucidate the mechanisms by which mutation of ANK3 disrupts neuronal circuitry. We generated a new mouse model with an Ank3 mutation, found in a family with bipolar disorder, to study the specific relationship between ankyrin-G and GABAergic synapses in vivo. The results show that this ANK3 human variant causes a major loss of GABAergic inhibitory and excitatory synapses. This thesis also explores the mechanism promoting GABAergic synapse loss in this Ank3 mutant loss-of-function ankyrin-G model to identify novel therapeutic targets for the treatment of bipolar disorder.

Azadeh Omidfar Sawyer
Architecture

Sustainable Design of Building Facades: Quantitative and Qualitative Methods to Assess Natural Light Through Complex Façade Design

Natural light has been the key element in valued architectural spaces affecting the energy demand, the ambiance of the space, and the ways occupants perceive the interior environments. Current lighting metrics focus on quantifying the amount of light on horizontal work surfaces, and overlook the importance of the spatial and dynamic nature of natural light affected by façade design. My interdisciplinary research goal is to develop an integrative methodology that goes beyond creating energy efficient buildings to designing holistic sustainable environments that support occupants' wellbeing. The primary focus of this research is on the design of building facades and how the design affects daylight distribution. This research identifies the relationship between spatial light distribution and human visual perception. The methods discussed in this study allow designers to differentiate the performance of façade systems, and to evaluate their effect on the spatial distribution of daylight and consequently occupants comfort and wellbeing.

Kara Palmer
Kinesiology

An In-Depth Analysis of Two Preschool Movement Environments

Motor skills are an important component in developmental trajectories of health. Motor skills should develop in early childhood, but not all movement environments support motor skill learning. This dissertation examines how motor skill learning is influenced by (1) the instruction and equipment in a movement environment, and (2) children's engagement in behaviors related to learning during a movement environment. Sixty children will complete one, 20-week movement environment: motor skill intervention (n=30) or a comparison condition (n=30). The comparison condition is identical to the intervention but does not include instruction. Children's motor skills will be assessed before, halfway through, and after the 20 weeks. Engagement in behaviors related to learning will be measured weekly using direct observation. Results from this study will determine how (1) two movement environments affect children's motor skills, (2) children engage in behaviors related to learning, and (3) the relationship between behaviors related to learning and changes motor skills.

Caroline Parins-Fukuchi
Ecology and Evolutionary Biology

Incorporating fossil data into the genomic revolution in evolutionary biology

New approaches to collecting and analyzing genomic data have changed the scope of questioning in evolutionary biology. However, fossils have been largely excluded from this revolution because they are known solely from morphology. Despite this, fossil data offer a uniquely direct view of past changes in the appearance and function of organisms that have historically occupied a critical role in the development of evolutionary theory through their synthesis with key biological concepts. In my dissertation, I aim to update this synthesis by developing novel conceptual and analytical approaches that leverage unconventional data sources to create a more complete evolutionary view that encourages a melding of these insights with those gleaned from genomic data. This continued synthesis will spur new advances in the understanding of evolutionary processes moving forward.

Dowon Park
Civil Engineering

An experimental and numerical study of time effects in silica sand

While time effects in silica sand are well documented, there is a distinct knowledge gap in regard to understanding the mechanisms that promote the time-dependent behavior of sand. A contact maturing hypothesis is advocated in this study, with an emphasis on the time-dependent behavior of inter-granular contacts. The rich surface texture of silica grains makes the surface asperities vulnerable to sub-critical fracturing, which is manifested as a delayed response to sustained loads. The study focuses on collecting experimental evidence at both micro- and macroscopic scales in order to support the hypothesis. Environmental factors, such as temperature, moisture, and chemical environment are tested to determine their influence on the rate of the contact maturing process. Numerical models are constructed to mimic the maturing process of individual contacts and the consequences on the time-dependent behavior of granular assemblies. The study improves current understanding of the sources of the time-dependent behavior of sands, and it allows addressing very practical engineering problems associated with sand compaction and setup of displacement piles.

Alyssa Penick
History

The Fate of the Parish: Established Religion, Power, and Property in the Chesapeake, 1720-1820

My dissertation explores an iconic moment in American constitutional history: the disestablishment of religion after the American Revolution. My thesis starts from the central insight that the eighteenth-century Anglican parish was both a religious body and a powerful public corporation in Southern communities. As part of the established church, parishes exercised wide-ranging administrative powers, from providing poor relief to inspecting tobacco, and acquired significant wealth including land and slaves. Investigating the power and property of the colonial Anglican Church leads me to challenge longstanding narratives of religious disestablishment after the Revolution, which typically emphasize the expansion of religious freedom. Instead, I demonstrate that disestablishment was a transfer of power and wealth in local communities. County governments assumed the civic responsibilities of Anglican parishes, and state legislatures seized church property. Disestablishment did not merely separate church from state but forged new meanings of religion and government in the American republic.

Andira Ramos
Physics

Precision measurement of the Rydberg constant using rubidium circular Rydberg states

A recent precision measurement of the proton radius yielded a significantly different value from the one thought to be well established, leading to what is known as the “proton radius puzzle.” In other words, despite the fact that the proton is one of the most abundant particles in our universe we do not know its size. This puzzle has triggered a lot of research efforts but it remains unresolved. One possible solution can be reached by performing a novel precision measurement of the Rydberg constant, R1, which is widely used to calculate atomic energy levels, such as those probed in the proton radius experiment. My thesis work represents the first time that cold rubidium circular-state atoms are used to measure R1. Atoms in circular states allow for the measurement of R1 to be independent of the proton size in question. My thesis will discuss the experimental and analytical progress towards achieving this measurement.

Taha Rauf
Social Work and Political Science

The Long-Run Impact of Religious Institutions on Development

How do religious institutions affect development? While religious institutions are frequently depicted and studied as part of history, their long-run role in affecting politics and economy remains uncharacteristically understudied. Religious institutions around the world have historically commanded political and economic resources, be it from the ruler or the laity. Yet, outside of the limited scholarship on the Church, religious institutions are little understood for their impact over time. I address the question of religious institutions by researching if and why the Islamic institution, Sufi Khanaqah, affects long-term development. Development being indicated by public goods, and district is the unit of analysis at which Khanaqahs and development will be analyzed. To identify the mechanism and estimate the effect more comprehensively, I will also examine the effect of covariates measuring Khanaqah patronage and trade routes. The research will be conducted in India focusing on the colonial and post-colonial period.

Thomas Rice
Astronomy and Astrophysics

Exploring the origins of nitrogen on terrestrial worlds

This thesis aims to address the origin and evolution of nitrogen compounds that would ultimately be delivered to young terrestrial worlds like the Earth. We plan to measure HCN distributions and abundances towards a number of low- and high-mass protostars. We are motivated to study HCN by a Herschel chemical inventory completed in the star-forming region Orion KL (Crockett et al. 2015), which hints that organic nitrogen-bearing compounds may provide much of the nitrogen that primordial planetesimals initially receive. HCN, as the simplest and most abundant species of organic nitrogen, is readily observed astronomically via its millimeter-wave transitions. By calibrating HCN abundance measurements against the water and silicate dust content in these pre-stellar and pre-main-sequence environments, we can compare our astrochemical nitrogen abundances to the cosmochemical record available from primordial Solar System bodies. We will develop and use chemical models to interpret the emission from gas-phase HCN in these stages, and infer the organic nitrogen content frozen into ices. A side exploration of this thesis, concluded in 2015, was a project to study and map large Galactic molecular clouds as traced by CO emission.

Stephanie Ross
Electrical Engineering: Systems

Control of Distributed Resources for Frequency Regulation of the Regional Power System While Maintaining Safe-Operation Locally

As renewable power generators become more prevalent, the power grid becomes increasingly susceptible to instability due to supply-demand imbalance. This dissertation focuses on the use of distributed resources to regulate the frequency of the regional power system, while simultaneously ensuring safe operation of local distribution systems. In this work, distributed resources that are inverter-connected are controlled to provide primary frequency regulation, and distributed resources that are temporally flexible are controlled to provide secondary frequency regulation. A hierarchical controller is designed to coordinate these frequency controllers such that the distribution network continues to operate safely. The full control system is demonstrated by simulating a regional power system with selected nodes expanded into full models of distribution networks. A successful demonstration of the control system will show that the system's frequency stability improves without compromising distribution network operation.

Kelly Russell
Sociology

Becoming Good Investments: Pay for Success and the Financialization of Deservingness

This dissertation investigates how Pay for Success (PFS), a public-private model for social policy, reshapes state spending on the poor and at-risk in the United States. PFS stipulates that governments should only "pay for success" under a PFS contract, private investors provide initial funding for a public intervention, which the government repays in full only if the intervention proves successful. Unlike other models of service provision, PFS treats public interventions as vehicles for cost savings and renders beneficiaries of these programs as "good investments." I illustrate how this process unfolds on the ground. Drawing on in-depth interviews with actors involved in PFS projects across three issue areas, I argue that PFS's investment framework reconfigures deservingness as a matter of which persons and programs promise the greatest economic returns, allocating resources to some but not all of those most in need and stratifying welfare state access in new ways.

Michael Schachter
Composition and Music Theory

On Musical Reasoning

For millennia, musical thought has been typified by a rationalist, logic-based epistemology, which, while powerful in its intuitiveness and clarity, struggles to satisfactorily handle the liminal, the ambiguous, exceptions to rules, and the pluralism attendant with aesthetic values—in short, the really good stuff. In this project, I propose an altogether new approach to music-epistemological reasoning that is simultaneously more dynamic and more robust than the traditional objectivist paradigm. After establishing a theoretical framework through literature review and philosophical argumentation, I demonstrate the efficacy of my new model through meta-analytical case studies. In the past half-century, similar foundational concepts have spurred major paradigm shifts in a wide range of scholarly disciplines, including history of science, cognitive science, psychology, and linguistics. This project aims to make a similar impact in the field of music theory, as well as translating to the practical domains of composition, performance, and pedagogy.

Hannah Segaloff
Epidemiology

Prediction and Prevention of Severe Influenza-Related Outcomes Among Hospitalized Adults

Vaccination and antiviral treatment can prevent influenza infection and reduce symptomology, though their utility in preventing severe disease is not universally accepted. Though hospitalized patients are most at risk for severe influenza, the in-hospital nature of the data collected from studies of these patients makes it difficult to study the impact of vaccination and antiviral treatment on influenza severity in this population. My dissertation uses data from the HAIVEN study to (1) identify predictors for severe influenza among hospitalized adults with influenza, (2) determine whether influenza vaccine effectiveness (VE) estimates in the hospital from traditional VE studies are biased, and to (3) develop an influenza severity score based on variables measured at hospital admission, and to use this score as an adjustment factor to efficiently and accurately measure the reduction in influenza severity associated with antiviral treatment and influenza vaccination.

Jinqi Shen
Statistics

Estimation and Inference in Spatial Statistics

Spatial statistics has been widely applied in different fields. This dissertation addresses several important problems in point processes and random fields. We propose a new method based on local polynomial method for estimating the nonstationary point process with a new setting that multiple replicas are observed. We study the estimator systematically by obtaining its convergence rate as well as the minimax rate and therefore demonstrate its optimality. For random fields, we propose a semi-parametric procedure for identifying multi-fractional Brownian motion and more importantly, studying its minimax rate and prove our estimator is optimal in convergence rate. Surprisingly this rate is faster than the classical nonparametric regression setting. Some data analysis will be included for both methods. I am currently working on establishing theory for general models of local structures of random fields with theories of tangent processes and extending our estimation method to the general model.

Quinton Skilling
Biophysics

Investigating the necessary neuronal and network features that facilitate memory consolidation

Neuronal activations account for information processing and memory storage in the brain. Despite decades of research, it is not conclusive how intracellular properties combine with network architecture to yield different dynamical states which may facilitate the storage of new information into memory. My dissertation combines computational simulations, in vitro experiments, and analysis of in vivo recordings to address these questions. I have found that memory consolidation preferentially occurs when the network dynamical state resides near a second-order phase transition, imparting features of critical dynamics to network-level processing. Further, I have tracked changes in the stability of functional network connectivity due to learning and found it to be a good indication both of memory formation and consolidation as well as the global network modality. Ongoing research builds upon preliminary results which show that intrinsic cell excitability gives rise to different dynamics in neuronal networks to investigate necessary features of memory consolidation.

Mia Stevens
Robotics

Safe Low-Altitude Small UAS Flight via Geofencing

As the number of small unmanned aerial systems (UAS) in operation continue to increase, so does the need for a reliable safety system and an infrastructure to coordinate the many vehicles operating at the same time. Geofencing is a system for defining volumes of airspace and preventing UAS from crossing the boundaries of specific volumes without permission. This work proposes: a mathematical definition of a geofence, algorithms for the creation and maintenance of a database to store all active geofences, a new algorithm to detect geofence boundary violations, and a set of guidance behaviors to prevent or correct violations of the geofence. The algorithms and definitions are tested through simulations and flight tests. The geofencing system is designed independent of the autopilot to enable consistency across different UAS.

Yilun Sun
Biostatistics

Nonparametric Robust Estimation with Missing Data and Dynamic Treatment Regime

Statistical inference can suffer from severe bias due to model misspecification. Therefore it is highly desirable to develop robust, flexible estimation techniques that require less model assumptions. In the first chapter, we propose a multiply robust kernel estimating equations (MRKEEs) method when data are missing at random. Compared to doubly robust estimators, MRKEEs allow multiple working models for missing mechanism and outcome regression, and the estimation is consistent if any one of these models is correctly specified. In the second chapter, we develop a Bayesian nonparametric machine learning approach that optimizes dynamic treatment regime in a multi-stage, multi-treatment setting. The resulting tree-based treatment regime offers flexibility and facilitates interpretability. In the third chapter, we extend the tree-based reinforcement learning method to estimate optimal dynamic treatment regime using the multiply robust regression estimators. Moreover, we study the theoretical properties of this method to investigate its optimality.

Rachel Surowiec
Biomedical Engineering

Novel Models to Study Bone Drug Efficacy In Vivo: Addressing the Fragility Phenotype

Osteogenesis imperfecta (OI) is a heritable bone disease characterized by low bone mass and poor bone quality. Clinical trials are especially challenging; there is a near ubiquitous reliance on animal models to understand effects of emerging treatments. We sought to develop a novel xenograft model using bone isolates harvested from pediatric OI patients to explore effects of treatment, safely, as a necessary bridge toward clinical trial. The rising demand for a suitable model to safely monitor bone therapeutics should be met with an equally safe and efficacious imaging method to characterize bone quality. Current standards rely on observed changes in bone mineralization using ionizing X-ray techniques. X-ray PREDICTS bone quality, yet other bone components have shown to correlate with ACTUAL bone quality and strength. Until now, these components remain “invisible” due to technical limitation. We aim to quantify the ENTIRE bone and its molecular components, safely, without harmful ionizing radiation using MRI.

Colin Tinsman
Applied Physics

Thermal Transport Studies in High Magnetic Fields Using Capacitive Microthermometers

Making sensitive thermal measurements in intense magnetic fields has always been challenging due to the large magnetoresistance of resistive thermometers at low temperature. Strontium Titanate has a dielectric constant which increases by several orders of magnitude at low temperature due to it being on the verge of undergoing a phase transition to a ferroelectric state. By making a capacitor with a Strontium Titanate dielectric, temperature can be sensitively measured in the presence of strong magnetic fields. These thermometers are suitable for making field dependent thermal transport measurements at cryogenic temperatures. The thermal Hall effect is of particular interest due to its potential application for studying materials of interest such as high temperature superconductors and topological insulators. The potential to make such measurements with this technique is demonstrated on bismuth metal and the dimerized quantum magnet system SrCu2(BO3)2.

ToniAnn Trevino
History

Mexican Americans and The War on Narcotics: Racialized Policing Practices and Community Responses in Postwar Texas

This study examines how Mexican and Mexican American communities in Texas experienced the postwar antinarcotics crusade and crafted neighborhood responses to narcotics policing. Where existing scholarship on mass incarceration and the war on drugs examines Mexican-heritage communities in the United States through immigration and border control practices, this dissertation argues that an assemblage of law enforcement agencies and carceral institutions policed Mexican subjects from Mexico to domestic urban spaces. I assert that Mexican-heritage communities in Texas utilized religious, medical, and social institutions to navigate an increasingly punitive antinarcotics landscape. To develop these arguments, I analyze: lawmaker rhetoric; federal, state, and local narcotics policing practices; and antinarcotics programming from community organizations, church groups, and federal narcotics hospitals from the 1930s to the 1970s. This research turns the gaze of carceral state scholars from state institutions to criminalized communities of color by uncovering how Mexican-heritage neighborhoods claimed rehabilitative alternatives to carceral institutions.

Vivian Truong
American Culture

"Whose City? Our City!": Asian American and Multiracial Movements Against Police Violence in New York

My dissertation traces the development of a multiracial struggle against police violence in New York City since the 1970s. Based on archival research and oral histories, my project focuses on the Committee Against Anti-Asian Violence and their community organizing in coalition with Black and Latino activists. Examining cases including the 1995 police killing of Chinese American teenager Yong Xin Huang in Brooklyn and criminalization of Vietnamese immigrant vendors in Chinatown, I argue that policing was used as a tool of removal to manage the growing population of Asian Americans and other people of color as New York became a "majority minority" city in the late 20th century. In the face of these contestations over urban space, movements against police violence had more at stake than the resolution of individual cases of brutality—they constituted a broader struggle over race and belonging in the spaces and future of the city.

Alexander Tye
Earth and Environmental Sciences

Crustal response to rapid changes in the balance of tectonic and gravitational forces: constraints from detrital geochronology and thermochronology

The initiation of collision between two continents is posited to rapidly change the balance of plate tectonic and gravitational forces on the continents involved. I apply detrital geochronology and thermochronology, using new approaches developed here, to quantify the effects of incipient collision in perhaps the only location where it is currently observable, the Greater Caucasus mountains. I develop a new statistical approach for comparing detrital geochronology samples, Bayesian Population Correlation (BPC), which for the first time permits unbiased quantitative inference of sedimentary provenance changes over space and time. I test BPC by using it to infer the timing and magnitude of the topographic response to force balance changes in the Western U.S. I then use BPC, thermochronology, and geologic mapping to quantify the timing, rate, and magnitude of the topographic and deformational response to incipient collision in the Caucasus. A new method for inferring earthquake histories is also presented.

Caroline Van Steendam
Civil and Environmental Engineering

Re-inventing Wastewater Treatment: from Sewage to Sustainable Water, Energy, and Nutrient Source

Motivated by increasing water and energy scarcity, my dissertation research focuses on designing and evaluating a novel domestic wastewater treatment system for cold to temperate climates. The overall goal is to build a novel treatment system capable of producing energy instead of consuming it, while achieving excellent effluent quality that allows for water reuse. To achieve this goal, I aim to (1) design and build a novel biofilm-enhanced anaerobic membrane bioreactor (BfE-AnMBR), (2) evaluate the treatment performance of the BfE-AnMBR at conditions relevant for cold to temperate climates, (3) characterize microbial activity in BfE-AnMBR biofilms and suspended biomass, and (4) conduct a BfE-AnMBR life cycle assessment. By integrating operational, microbial, and life cycle information to guide engineering principles, my dissertation research will support the development and subsequent implementation of a creative and sustainable approach to wastewater treatment.

Arushi Varshney
Human Genetics

Understanding the mechanisms of genetic predisposition to type 2 diabetes

Type 2 diabetes (T2D) is a complex disease that affects an estimated 415 million people worldwide. Genome wide association studies (GWAS) have identified nearly 100 independent genetic signals that encode predisposition to this disease. However, the underlying biological mechanisms driving this predisposition are largely unknown, which is a serious impediment in designing precision therapeutic strategies. The focus of my research is to untangle the genetic complexity of T2D to better understand the biological mechanisms of how disease predisposition is encoded in our DNA. Specifically, I aim to understand how T2D genetic risk variants modulate gene expression in orchestrating disease mechanisms. I utilize high throughput molecular profiling data in human pancreatic islets and other diverse tissues along with human and rodent cell line model systems and employ computational and experimental approaches to map functional signatures of genetic variants associated with T2D.

Logan Williams
Materials Science and Engineering

Atomistic modeling of semiconductor alloys for optoelectronic, thermoelectric, and photovoltaic applications

The functional properties of semiconductor alloys can be engineered beyond the limitations of their ingredients. Recent advances in high-performance computing and methodologies enable the atomistic modeling of semiconducting random alloys with predictive accuracy. My calculations discovered that incorporating boron into InGaN, the active material in blue LEDs (2014 Nobel Prize in Physics), maintains its desirable electronic properties while better matching its structure to the underlying GaN. This allows the growth of thicker active layers, improving the LED efficiency at high power. Moreover, I predicted that Cu4TiSe4, a newly synthesized semiconductor, is promising for efficient ultra-thin solar cells, while its properties can be engineered by alloying with Cu4TiS4. Last, my work investigates the properties of entropy-stabilized functional materials. I discovered that GeSnPbSSeTe, the first entropy-stabilized semiconductor, is stable although alloys of its ingredients phase segregate. My results enable the design of new materials for photovoltaic, thermoelectric, and solid-state lighting applications.

Travis Williams
Romance Languages and Literatures: Spanish

Ways of Seeing: Violence and Visibility in Modern Mexican Cultural Production

More than a decade after President Felipe Calderón initiated an escalation of the armed conflict between criminal drug-trafficking organizations and military and police forces in Mexico, violence, impunity, and corruption continue to shape public life. According to the Secretary of the Interior, more than 27,000 people disappeared in the country between 2007 and 2016; while in 2016 alone, more than 20,000 people were murdered. These phenomena reflect a fundamental breakdown in the relationship between the state, public space, and the licit and illicit flows of capital and labor that traverse Mexico, with macabre imagery of public acts of violence making visible the nation-state's failure to mediate and give coherent form to these relationships. Tracing a genealogy of representations of public space in visual and literary imagery, my dissertation examines the interrelationship of violence, visibility, and public life in Mexico from the post-revolutionary period to the present.

Huayu Xu
Economics

The Formation of Human Capital and Health in Developing Countries

The purpose of this dissertation is to study the importance of institutions and labor markets in the formation of human capital and health in the developing world. In chapter 1, I propose to use a unique natural experiment in Taiwan to investigate the role of bureaucrat recruitment in shaping individuals' incentives for human capital investment. The preliminary results suggest that a higher probability of succeeding in the civil exam and being selected as an elite government official encouraged men to invest more in schooling. However, these gains for men might come at the expense of their female siblings. In chapter 2, I propose to evaluate the long-run health and educational consequences of a land titling program in China, which improved the land rights among the poor and substantially increased agricultural productivity. The results suggest that an early-life exposure to this program improved individuals' health, education, and labor market performance in later life. However, an exposure at critical school ages depressed the investment in human capital, making individuals more likely to remain in agriculture. In chapter 3, I propose to use a large randomized controlled trial in India to study the impacts of skill training and improved migration opportunities on women and their family members, with a focus on health, schooling, and other welfare outcomes. The random assignment of training and employment opportunities among women allows us to overcome the endogenous selection into training programs and migration and estimate their causal impacts on rural households.

Nicole Yadon
Political Science

The Politics of Skin Color

Heterogeneity in skin color is linked to vast differences in life experiences, both within and across racial groups. For example, darker-skinned blacks have lower incomes, less education, poorer health, and receive harsher criminal sentencing than lighter-skinned blacks. While most research examines racial groups as uniform collectives, my dissertation explores skin color as a meaningful political identity beyond race. Drawing evidence from the nationally representative 2012 American National Election Study, two online surveys, and 67 in-depth qualitative interviews, I find that skin tone is indeed politically and socially meaningful. I demonstrate that (1) skin tone is a salient identity for blacks, especially those with darker skin, and (2) skin tone influences policy preferences. Next, I will conduct two experiments linking candidate skin color and political support from both black and white voters. Overall, I demonstrate that skin color is operating as an important but rarely acknowledged force in American politics.

Xinchen Yan
Computer Science and Engineering

Learning controllable and structured representations with deep generative models

Generative modeling of structured data is one of the frontier research topics in deep learning and AI. This study focuses on three related research areas: controllable image generation, deep generative modeling of structured data, and unsupervised learning of 3D geometry generation. Being able to perceive and plan in a way comparable or even superior to human-level performance is one of the ultimate goals of AI. However, building such an intelligent agent is very challenging due to high dimensional sensory inputs from the physical world and many variations involved during interactions. The aim of this study is to solve the following sub-tasks: (1) efficiently recognize and disentangle factors from the sensory input, (2) understand the way factors entangled so as to effectively reconstruct and interact with the physical world, and (3) generalize the model learned from one domain to novel settings involving unseen categories and environments.

Xiaoyang Ye
Higher Education

Reduce inequality in college access: Examining scale-up policy solutions using randomized experiments

Despite rapidly growing evidence in the past decade that behavioral interventions increase college opportunity for U.S. low-income students, we know very little about the effectiveness of these interventions in other contexts. To fill this gap, I provide novel evidence of interventions to address the college undermatch problem based on large scale experiments in China. I have designed and conducted the Bright Future of China Project, which supports low-income high school graduates with a series of college application interventions. Results from the 2016 pilot randomized controlled trial (RCT) suggest that knowledge-based personalized advising programs are more effective than simple information provision. But these resource- and cost-intensive interventions are not scalable to large groups. In the 2017 full-scale RCT among 500,000 students in three of the poorest Chinese provinces, I examine two potential scale-up solutions: incentive policies to increase school organizational effectiveness, and big data-driven methods to simplify instruction and learning.

Jennifer Zavaleta
Resource Policy and Behavior

Safety in Diversification

Academics and development agencies often promote income diversification as an adaptation strategy that can limit the negative effects of shocks by building resilience. However, we lack the empirical evidence that income diversification leads to higher or more regular incomes or that families with diverse income portfolios are better situated to rebound from shocks. This dissertation fills a critical gap in our understanding of the process that generates and the outcomes that result from livelihood diversification, particularly throughout seasons and between men and women in the same household. This work is based in rain-fed regions of India, which are highly susceptible to the negative effects of climate variability and are home to millions of rural poor. With over 1,200 household surveys conducted throughout the year and over 125 interviews, this data set provides the greatest detail, most diverse sample, and highest temporal resolution of any study on livelihood diversification to date.

RACKHAM GRADUATE SCHOOL
UNIVERSITY OF MICHIGAN

Rackham Graduate School
University of Michigan
915 E. Washington Street
Ann Arbor, Michigan 48109-1070
Phone: (734) 764-4400
http://www.rackham.umich.edu

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