Kyla Dahlin  
Presidential Fellow  
Biology  

I am interested in vegetation patterns and how these patterns change as we shift from a local to a global perspective. At the landscape scale, we know that vegetation patterns are controlled by a combination of environment, historical events, and population dynamics, but the relative importance of these three elements is hotly debated. Using emerging airborne remote sensing technologies I am working to identify and measure how plant structure and species composition vary within and between ecosystems and to develop models that quantify this variation. My doctoral research is based in California, where our distinctly “patchy” vegetation is ideal for addressing these questions. Although there are theoretical aspects to my work, I am most interested in the implications for environmental restoration and climate change adaptation. In a rapidly changing world, understanding today’s ecosystems will help us better prepare for the future.

Marie de Marneffe  
Presidential Fellow  
Linguistics  

Computational systems today understand, at most, the literal meaning of human language utterances (though typically much less). However, much of the meaning conveyed in language use is more subtle and context dependent. When a mother says to her screaming child with a cut finger “You’re not going to die,” the utterance doesn’t convey what it literally means, but rather that the cut isn’t serious and she wishes the kid would quiet down. The goal of my research is to provide computational models that capture the meanings people assign to utterances within texts, not simply to sentences in isolation. I do this by synthesizing linguistic knowledge and machine learning techniques over large amounts of textual data in order to be able to recover implicit information conveyed by utterances, to understand the relationships between utterances, and to understand whether events described in utterances are true in the real world.
Jamie Dunckley  
Presidential Fellow, Civil and Environmental Engineering  
Coral reefs are among the most biologically diverse and economically important ecosystems on the planet. They are valued at over $375 billion yearly due to services such as surge protection, tourism, and subsistence fishing. Unfortunately, it is estimated that by 2030 60 percent of all reefs will be damaged. The mechanisms behind what drives a healthy reef system are currently not well understood. Specifically, how are they able to thrive in such nutrient-deficient waters? Fluid mechanics play an important role in coral nutrient transfer as corals cause waves to break, resulting in complicated oscillating turbulent flows. Through the use of new measurement techniques and the combination of biogeochemistry and fluid mechanics, I hope to connect nutrient flux rates with specific water velocities and eddy length scales. This would provide a better understanding of reef nutrient systems and would help predict how projected climate changes might alter future corals.

Miriam Kolar  
Presidential Fellow, Music  
Why should archaeologists take interest in the acoustics of ancient spaces? Using acoustic knowledge, what questions can be answered about the possible functions of a space and its potential to affect human experience? I am developing methodologies for studying and exploring ancient soundscapes, basing my research in 3,000-year-old Chavín de Huántar, Peru. Chavín provides arguably ancient acoustic conditions in many enclosed site areas and an archaeological record with significant evidence for cultural interest in sensory experience: architectural features that manipulate the senses of physical orientation, vision, and hearing; artifacts that depict hallucinogenic plants and their effects when ingested, along with tools for their preparation and use; and decorated Strombus galeatus shell horns/trumpets that imply specific and codified sound production. Auditory implications of acoustic features must be analyzed and interpreted in the context of this and other archaeological evidence. The methodologies developed in this project cover data collection, analysis, and interpretation. Outcomes will be applied in public interfaces for exploring acoustics and the auditory dimension of Chavín.

Liang Liang  
Lubert Stryer Interdisciplinary Graduate Fellow  
Bio-X SIGF  
Applied Physics  
I am incorporating advanced fly genetics using a novel noninvasive optogenetic approach that combines fiber optic laser-illuminated retinal proteins (opsins) with genetically encoded calcium indicators for studying the neural circuits known to be related to smell. Manipulating and recording the neuronal activity with high spatiotemporal resolution will help us to better understand the neural coding in the olfactory circuitry, and to gain insight into the organizational principles of neural systems.
Li Ma, Larry Yung Fellow, Bio-X SIGF, Statistics

Epistasis, or interactions between genes, has long been speculated to play important roles in the epidemiology of common diseases. However, existing approaches to testing interactions have achieved limited success and are most ineffective in the presence of genetic heterogeneity—when people have (clinically) the same disease for different genetic reasons.

My research focuses on developing statistical and computational methods for testing interactions that are robust to genetic heterogeneity. The goal is to use large-scale computation to seek genetic patterns that account for a small proportion of the patients. The key is to achieve this in a computationally efficient and statistically rigorous way.

Aila Matanock, Presidential Fellow, Political Science

In March 2009, the candidate for the Farabundo Marti National Liberation Front, a former party of guerillas, was elected president of El Salvador. This event is a milestone in the peaceful resolution of a major civil conflict in that state. In other cases, when formerly violent opposition groups participate in elections they fare poorly and have no impact on policy. Alternatively, they continue to use violence while participating, or abandon the political process to focus on violence once again. What explains electoral participation by these groups and the diverse range of conflict resolution outcomes? My research addresses those questions using both comparative case studies and large-N empirical analysis normally associated with political science. I also turn to social psychology to think about how to measure the level of popular support different militant groups possess. I explore this measurement through survey experiments in Egypt and (hopefully!) Colombia.

Cecilia Hyunjung Mo, Presidential Fellow, Business

Despite the seriousness of the human trafficking problem, there is a severe lack of data, scant published information, and incomplete understanding of causal factors. My research examines the factors that induce and facilitate trafficking on the supply side, and the identification of potential policy instruments for addressing vulnerabilities created by these factors. The complexity of the trafficking problem entails an interdisciplinary research approach.

As such, I am collecting original fieldwork data and using analytical tools and modeling techniques from economics, political science, sociology, and psychology to illuminate the set of factors that make some children so vulnerable to human trafficking. Namely, I marry a game theoretic approach with an analysis of social structures, attitudes, and belief construction to understand trafficking vulnerability. In so doing, it is my hope that the study will provide valuable lessons that can assist practitioners in their efforts to construct program and policy instruments that more effectively address child trafficking vulnerability.
Peter Olcott, Presidential Fellow, Bio-X SIGF, Bioengineering

Positron Emission Tomography (PET) is a noninvasive, in vivo, functional, molecular imaging technology that is an important tool for clinical disease management and preclinical small animal research. PET is plagued by poor spatial resolution caused both by the necessity of minimizing radioactive dosage to the patient and by challenges with detecting very high energy photons (gamma rays) with high spatial resolution. The spatial resolution of PET can be greatly increased by detecting the arrival time of high energy photons in the picosecond realm. I wish to improve the time resolution by more than an order of magnitude over the current generation of time-of-flight (ToF) PET systems by investigating readily available nonlinear photonic materials (instead of scintillation crystals) for use as a ToF PET detector.

Shawn Ouyang, Affymetrix Bio-X Fellow, Bio-X SIGF, Chemical and Systems Biology

Zebrafish have a unique ability to regenerate several of their tissues, including those of the heart, retina, spinal cord, and fins. Understanding the molecular mechanisms that underlie this process should provide insights into how tissue regeneration is achieved and perhaps strategies for their reactivation in humans. My research goal is to decipher the molecular and cellular events associated with larval tail regeneration, and I have identified several genes that are upregulated or downregulated in posterior cells after the tail is amputated. I am now using an interdisciplinary approach to determine the roles of these genes in the regenerative process.

Maria Perez Zurita, Presidential Fellow, Education

I am investigating the theoretical and empirical effects of teacher performance-based pay systems (e.g., merit pay). By conducting a controlled laboratory experiment I will address how teacher attitudes and preferences toward incentive schemes could: 1) influence the design and implementation of merit pay systems; 2) affect teacher motivation and the selection of teachers; and 3) affect the compliance with such a compensation reform. I am also developing a computable general equilibrium model to understand and simulate the potential effects different teachers’ incentive schemes could have on the education system as a whole. I have also worked closely with Susanna Loeb conducting research on how differences in teachers’ value-added measures affect teacher attrition. I use econometric as well as behavioral methods to investigate pressing policy-relevant issues in education.
Amy Pickering  
Presidential Fellow  
Emmett Interdisciplinary Program in Environment and Resources

My dissertation work is motivated by the goal to reduce the global prevalence of diarrheal and respiratory diseases. Together, these annually cause more than three million child deaths under the age of five. Handwashing with soap has been found to be one of the most effective and low-cost strategies to reduce these illnesses, yet actual handwashing rates remain low around the world. To address this problem, I develop and evaluate scalable interventions designed to improve hand hygiene and health in developing countries. I also investigate important barriers to handwashing behavior change in resource-poor settings, such as water availability in Africa. Finally, I work toward developing valid and reliable indicators that can be used to measure hand hygiene behavior in the field.

Maryanna Rogers  
Presidential Fellow  
Education

My research investigates motivation during the creative process at both the individual and group level. Based on a mixed methods approach, I create case studies to illuminate how individuals and teams negotiate changes in motivational-emotional states and differences in domain and creativity skills. Results from this research will inform scaffolds for the creative process as well as contribute to our understanding of motivation and project-based learning.

Karen Thompson  
Presidential Fellow  
Education

United States schools serve a growing number of students who begin their education not yet fluent in English. Much debate exists around the appropriate materials and methods for facilitating students’ acquisition of English, and different assumptions about how language acquisition occurs underlie this debate. Although some linguists have attempted to influence educational practice, scholarship from linguistics is not well integrated into education. By examining the assumptions about language acquisition that underlie curricular materials and instructional practices, my research aims to foster dialogue between linguists and educators, with the ultimate goal of improving educational outcomes for English learners.