Penn Undergraduate Research Mentoring Program
Project Descriptions

Summer 2017

Application and instructions at ***http://www.upenn.edu/curf/research/grants/purm***

Unless otherwise noted, current freshmen and sophomores may apply for any listed project.

Students are encouraged to learn more about faculty interests by reviewing faculty webpages and recent publications to determine your interest level in particular projects. Projects are listed by primary department but many of them are interdisciplinary in nature, therefore we suggest that you use keyword searches in this document to identify additional projects that would be of interest to you.

To avoid confusion, students are asked not to contact faculty about their projects until contacted for an interview or the PURM selection process has been completed.

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Annenberg

COMMUNICATION

Emily Falk

Project 1: Can neuroscience help make better ad campaigns? Neural mechanisms of health behavior change

Students will assist a study examining the neurocognitive mechanisms of health communication using functional magnetic resonance imaging (fMRI). The study investigates the brain circuitry involved in processing health information and increases in physical activity. Students will be responsible for preprocessing and analyzing fMRI data as well as various behavioral assessments, such as accelerometer data, implicit association tasks, and self-report surveys. To do this, students will learn basic data analytical techniques and other statistical skills. This is a great opportunity for someone interested in the use of functional neuroimaging data, and/or psychological research more generally. Students would also have regular meetings with their advisor (Yoona Kang, PhD) and discuss analysis and design issues related to using human neuroscience methods (e.g., fMRI, fNIRS), as well as recent findings related to communication and social neuroscience.

Project 2: Getting brains in sync: Can neuroscience help improve interpersonal communication?

Students will assist a study testing interventions that aim to increase the degree to which listener's brain mirrors that of speaker's (neural synchronization/coupling) using functional near infrared spectroscopy (fNIRS). The intervention includes components of meditation practice, previously shown to activate the brain circuitry involved in processing other-focused (vs. self-focused) information. We will test whether exposure to meditation vs. control activity prior to interpersonal interaction can increase neural coupling and supportive behavioral outcomes. Students will be responsible for preparing study materials, recruiting and meeting with participants and running them through the study protocol, including behavioral and fNIRS studies. By the end, students will be able to independently run neuroimaging protocol, proficiently perform neuroimaging data preprocessing, and understand basic theories of neuroimaging study designs. This is a great opportunity for someone interested in the use of functional neuroimaging techniques, and/or psychological research more generally. Students would also have regular meetings with their advisor (Yoona Kang, PhD) and discuss analysis

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and design issues related to using human neuroscience methods (e.g., fMRI, fNIRS), as well as recent findings related to communication and social neuroscience.

Yphtach Lelkes

Project 1: The Effects of Voter Identity Laws on Perceptions of Political Legitimacy
Rising Junior only

Perceptions of electoral legitimacy, i.e., that elections were fairly conducted and that the winner of the vote has legitimate authority, underpins democratic society. Recently, a number of states have enacted voter identity laws that may impact electoral legitimacy. Proponents of these laws claim that they increase perceptions of legitimacy, while opponents claim they decrease these perceptions. Proponents of such laws argue that they protect the integrity of the electoral process, by making sure that only those who are legally allowed to vote participate. Opponents of such laws argue that the primary goal of these laws is to suppress voter turnout, especially among minorities. This project assesses the merit of these two arguments by assessing effects of voter identity laws on perceptions of legitimacy by utilizing a longitudinal survey from 2012-2016, which asks a nationally representative sample of respondents their perceptions of electoral legitimacy. We use variation over time and between states in voter identity laws to identify effect.

The student who works on this project will gain a number of important research skills. First, he or she will be asked to collect and synthesize literature on perceptions of legitimacy as well as voter identity laws. Second, they will gain data gathering expertise. We will code the strictness of each state's voter identity laws for each year of the dataset. We will also be gathering census information on each state using the Census DataFerrett application. Finally, the student will help analyze, interpret, and write-up results. Students should have some background in data analysis, preferably using R.

Jessa Lingel

Project 1: Transnational analysis of social media feeds of police ***Rising Junior only***

This project involves a qualitative analysis of social media feeds of the police. In the context of research on social media and the police as an institution, a growing body of research is emerging around activist uses of online platforms (particularly Twitter) for documenting police violence, networking with activists, and promoting social and political causes. There is far less information, however, on how the police are currently using social media to interact with their local communities, inform constituents of events and issues, and how they construct their work

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as police officers. This project will compare social media feeds in two contexts: the Philadelphia Police Department's twitter feed and a TBD counterpart in Mexico.

Students duties will involve:

-conducting a preliminary literature review about police media

-building datasets of tweets from a small number of Twitter accounts

-analyzing this corpus in terms of content, affect and social networks

Skills that are useful include:

-familiarity with annotated bibliographies

-knowledge of Spanish

-basic knowledge of Twitter's API

This work also involves a collaboration with Joe Sanchez, an assistant professor at CUNY – Queens.

Sharrona Pearl

Project 1: #sorrynotsorry: the power dynamics of mediated forgiveness

In this project, I explore mediated third-party requests for forgiveness. Drawing on American televised news interviews of relatives of gun violence victims and survivors of sexual assault from the past year as my empirical case studies, I track who is asked to offer forgiveness, by whom, and whether it is given. I am particularly interested in disparities between black and white victims, and male and female victims. I close read these examples in the context of media practices more broadly to consider the racial and gender dynamics of this very particular form of forgiveness in absence of apology. I situate this particular phenomenon in the history of structural oppression of women and people of color and show how to media participates in disempowering these groups by coercing forgiveness and in so doing, robbing them of their right to anger, vengeance, and recourse. For this research, I would need assistance compiling an archive of these events and putting them online to produce an open-source website to which anyone could contribute. It is my hope to develop a broad theory of the gendered and raced implication of third-party requests for forgiveness, and I want to put it online and crowd source it. My RA would develop important skills in archival media research, gender and race theory, and activist uses of academic research.

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SOCIOLOGY

Guobin Yang

Project 1: The Changing Landscape of Environmental Activism in China

China's environmental movement was born in the mid-1990s with the founding of a small number of environmental NGOs in Beijing. The main issues of concern to them were nature conservation, animal protection, and recycling. Since then, however, the environmental movement in China has undergone significant change. Originally an urban NGO movement, it now consists of both urban activism and rural pollution-related protests. While the first-generation of environmental NGOs is still active, a new generation of activists has appeared who have formed grassroots NGOs that differ from their first-generation counter-parts. Pollution and food safety, which were not on the agendas of environmental activists in the 1990s, have now taken center stage in China's environmental movement. Influential cases of pollution-related protests have broken out in both urban and rural areas. This project aims to delineate and explain the changes in the forms and types of environmental activism in China in the past decade. Building on my earlier articles on environmental NGOs, green public spheres, and rural environmental protest, I ask: What changes have taken place in the field of environmental activism in China in the past 15 years? Has it become more or less institutionalized? Against the background of changing political and ecological conditions, do Chinese environmental activists develop new strategies, identities, and discourses? What configuration of circumstances best explain these changes?

For this project, I will need a research assistant to prepare an annotated bibliography of the scholarly literature on environmental activism in China since 2005. Chinese-language skill is a plus.

Project 2: The Networked Formation and Dissemination of Chinese Internet Memes

Internet memes are an important part of Chinese internet culture and politics. Often appearing as popular responses to various forms of social injustices and abuses of political power, they are the most memorable icons of online resistance and protest in China. Containing political satire and humor, they have appeared in large numbers in the past two decades. However, given the prevalence of online censorship in China, the proliferation of internet memes presents a puzzle.

How are they produced? What are their linguistic and stylistic features? How do they spread online? What types of issues are more likely to yield internet memes? What social and political functions do they serve? Despite occasional case studies, there is no systematic analysis of these important questions.

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Building on my long-term work on internet activism in China and my recent co-authored paper "The Networked Practice of Online Political Satire in China: Between Ritual and Resistance" (International Communication Gazette, Vol.77, No.3, 2015), this project aims to conduct a systematic empirical analysis of Chinese internet memes.

Research assistant's main responsibility is to collect data and build an Excel database of major Chinese internet memes in the history of the Chinese internet. This project requires Chinese-language reading and writing competence, skills to search and browse the Chinese-language web using Baidu and Google, as well as skills to use the Chinese Academic Journals database (to which Penn libraries subscribe to).

Project 3: Narrative Agency in Hashtag Activism on Twitter: An Empirical Study

Hashtag activism happens when large numbers of postings appear on social media under a common hashtagged word, phrase or sentence with a social or political claim. Many such cases have happened in recent years, but there are only scattered case studies. Built on my recent article entitled "Narrative Agency in Hashtag Activism: The Case of #BlackLivesMatter" (Media and Communication, Vol. 4, No. 4, 2016), this project aims to conduct a systematic empirical analysis of the forms and contents of hashtag activism on Twitter in order to understand their formation and impact. The questions I will ask include the following:

Do hashtags differ in syntactical structures? Are single-word hashtags (e.g. #change) less likely to spread than hashtags with complete sentences (e.g. #WhyIStayed)? Are contentious hashtags more likely to contain verbs or images? How are personal stories told within Twitter's 14--character limit? In short, is the spread of contentious hashtags associated with particular rhetorical, stylistic, and narrative forms? What issues are more likely to turn into hashtag activism? What role do online opinion leaders play in the dissemination of hashtag activism?

Research assistant's responsibility is to collect data and build an Excel database of cases of hashtag activism. This will require basic skills of research using Google Scholar, Twitter, Excel, and academic journal databases.

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Arts and Sciences

ANTHROPOLOGY

Theodore Schurr

Project 1: The Genetic History of Mingrelia, Western Georgia

In this project, we will investigate the genetic diversity of contemporary populations from Mingrelia, Western Georgia. We will specifically investigate (1) whether the earliest modern human settlers in the Caucasus originated in the Near East and Iran; (2) if western Georgia is genetically distinctive from eastern Georgia; (3) if Georgian ethnolinguistic groups (Svan, Mingrelian, Laz, Georgian) and those of eastern Anatolia share a common ancestry; and (4) whether genes and languages co-evolved in the South Caucasus. Through this approach, we will generate the highest resolution genetic data yet available for Georgian populations. Our data will transform both the regional and global knowledge of some of the least known but most important population dynamics in Eurasian prehistory. To address these questions, we will conduct a high-resolution analysis of mitochondrial DNA (mtDNA) and Y-chromosome sequence variation in Mingrelian individuals. While working on this project, the student will learn various methods of genetic analysis, including PCR amplification, gel electrophoresis, DNA sequencing, and SNP and STR genotyping, among others. In addition, the student will be trained in basic statistical and phylogenetic methods of DNA sequence analysis so that he/she can conduct a comparative analysis of genetic diversity in Georgia, the Caucasus region and the Near East. For his/her contribution to the project, the student will be given co-authorship on the manuscript that describes the genetic findings for Mingrelian populations.

Project 2: Mitogenome Variation in Ethnic Populations of Northeast Pakistan

In this project, we are conducting a detailed genetic and ethnographic study of populations living in Buner and Swabi area of Khyber Pakhtunkhwa in Pakistan. This research will help us to elucidate their origins in the region, define their affinities with the populations from the Indian subcontinent, West Asia and Central Asia, and delineate the relationship between genetic and identity formation in contemporary villages from this province. Approximately 700 unrelated individuals of five major ethnic groups (Yousafzai, Gujars, Syeds, Jadoon and Tanoli) from the Swabi and Buner area are being analyzed for mtDNA and Y-chromosome haplogroup diversity. We need to further characterize whole mitogenome sequences in these populations to obtain the highest resolution view of maternal genetic variation in them. Thus, the student involved in this project will learn how to conduct mitogenome sequencing and employ statistical and phylogenetic tools to interpret the patterns of genetic variation in the Pakistani populations. The

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resulting will allow us to reconstruct the movements of human groups into and out of this region for the past 60,000-70,000 years, and also begin elucidating the histories of the ethnic groups themselves. For his/her contribution to the project, the student will be given co-authorship on the manuscript that describes the genetic findings for the Pakistani populations.

Project 3: Mitochondrial DNA Variation in Mayan-Speaking Populations of Mexico

In this project, we will work with Mayan-speaking populations of Mexico to explore their genetic ancestry and population history. The study will involve the high-resolution analysis of mitochondrial DNA (mtDNA) sequence variation in the Yucatec Maya (Campeche), Ch'ol, Chontal, and Tzotzil (Tabasco), and Teenek (San Luis Potosi). In general, the name "Maya" is a collective designation to describe the peoples of the Mesoamerica region that share some degree of cultural and linguistic heritage (including groups from Belize, El Salvador, Guatemala, Honduras, and Mexico). However, "the Maya" also encompasses many distinct populations, societies, and ethnic groups that have their own particular traditions, cultures, and historical identity. In addition, the Teenek speak Huastecan, a Mayan language related to those spoken further south and east in Mexico and Central America, raising intriguing questions about its genetic relationship to them. In light of this history and ethnolinguistic diversity, this analysis will reveal important new details about the population structure, phylogeography, admixture and population dynamics of these indigenous Mexican groups. The data from this study will also contribute to our understanding of Mexico's role in the peopling of the Americas, the relationship between linguistic and genetic diversification in Mexico, and the impact of Mayan civilizations on patterns of genetic diversity in Mexico. While working on this project, the student will learn various methods of genetic analysis, including PCR amplification, gel electrophoresis, DNA sequencing and SNP genotyping, among others. In addition, the student will be trained in basic statistical and phylogenetic methods of DNA sequence analysis so that he/she can conduct a comparative analysis of Native Mexican mtDNA variation. For his/her contribution to the project, the student will be given co-authorship on the manuscript that describes the genetic findings for this population.

ASTRONOMY

James Aguirre

Project 1: The Philadelphia Community Radio Telescope: a Resource for Teaching and Outreach

The student will help in the continued conversion of the 10-meter satellite dish on the roof the Enterprise Center at 46th and Market into a teaching and outreach tool for Philadelphia schools,

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including Penn courses and local high schools. We are developing a camera for this satellite dish which will make an image of the sky a radio wavelengths. The student would help develop curricula and materials for using the telescope, including a public-facing web page, which present the technical aspects of its operation and the uses and interpretation of the images and data produced. In addition, the student would help in the testing of a mini-radio telescope based around a Dish Network satellite dish, which can be taken to classrooms and local science fairs.

The student will learn both technical aspects of radio astronomy and instrumentation, as well as communication of scientific ideas to high school students, undergraduates, and the general public. Documenting the educational materials and activities is an essential part of the work, including the possibility of writing up the material for publication.

Project 2: Towards Finding the First Galaxies in the Universe

The direct detection of the first galaxies is enormously difficult due to their faintness, but it is possible to observe their effects as they ionize the hydrogen between galaxies when the universe was only a few hundred million years old. This is possible because hydrogen emits and absorbs radio photons in its ground state, the detection of which is possible for instruments operating the FM band. We are currently analyzing an extensive archive of data from the Precision Array for Probing the Epoch of Reionization (PAPER; http://http://eor.berkeley.edu) and have begun collecting data from the new Hydrogen Epoch of Reionization (HERA; http://reionization.org) instrument.

The student would work closely with a graduate student on the development of imaging and calibration algorithms for this data. All data analysis software is written in Python; previous experience with this or some data-oriented programming language is strongly preferred. Some knowledge of astronomy and astrophysics is also a plus.

The student would learn aspects of radio astronomy and interferometry (including signal processing and Fourier theory) and data analysis of large data sets. There is potential for contribution to a refereed publication or publications on the scientific results or data analysis methods developed.

Masao Sako

Project 1: The Dark Energy Survey Supernova Survey

Penn is involved in an exciting cosmology experiment called the Dark Energy Survey (DES), which will make the most precision measurements of the expansion history of the Universe and help understand the mysterious nature of dark energy. Using a massive 520-Megapixel camera on the Blanco 4m telescope in Chile, this 5-year project will measure the detailed properties of over 300 million galaxies and discover thousands of supernova explosions billions of light years

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away. The PURM student will help search the data for astronomical transient objects including nearby and distant supernova explosions, supermassive black holes, and erupting stars. The projects will heavily make use of coding in Python and C, however, no prior experience is required. More information about DES can be found here -- http://www.darkenergysurvey.org/

Project 2: Search for Planet Nine

There is now mounting evidence that there is a yet-to-be-discovered massive planet in the outskirts of our Solar System. This planet called "Planet Nine" is expected to be ten times the mass of the Earth and well beyond the orbit of Pluto. We have imaging data from the Dark Energy Survey (DES), which has observed a large portion of the southern sky that overlaps with the most likely place where Planet Nine might exists. The PURM student will help analyze the data, search for candidates, and study the survey efficiency for discovering this object. More information about DES can be found here -- http://www.darkenergysurvey.org/

BIOLOGY

Nancy Bonini

Project 1: Modifiers of ALS disease toxicity in Drosophila

The Bonini laboratory uses Drosophila as a research model to study the mechanisms of human disease. We have various transgenic lines that express human disease associated proteins. We have identified modifiers of toxicity that require detailed analysis. Our current project involves an ALS disease model by expression of the protein TDP-43. We have defined that genes of elongation complexes mitigate TDP-43 toxicity and are investigating the mechanisms by which this suppression occurs. Previous work with Drosophila is desirable. Work involves growing flies, selecting animals, aging animals, preparing animals for analysis by biochemical techniques and histology.

Kimberly Gallagher

Project 1: Mechanism of Intercellular Protein Movement

To control development and metabolism, multicellular organisms must coordinate and maintain communication between cells. In plants, much of this signaling occurs via the intercellular transport of transcription factors. Transcription factors made by one cell can travel into the neighboring cell, enter the nucleus, bind DNA and initiate changes in transcription. Examination

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of many mobile proteins in plants has shown that most (if not all) move via plasmodesmata (PD; plasma membrane lined channels that extend between cells). However, what remains unclear is how proteins get to PD and how access is controlled. Preliminary data using the SHORT-ROOT (SHR) transcription factor as a model system, suggests roles for the endomembrane (largely late and early endosomes), the cytoskeleton, nuclearcytoplasmic shuttling and the environment in the regulation of SHR movement. The goal of this proposal, is to delve further into the regulation of SHR movement, both as a model for understanding how intercellular trafficking of proteins is controlled and to better understand how the intercellular trafficking of proteins patterns development. The student involved in this project would work with the two post-docs currently on the project to examine post-translational modifications of SHR and to screen for conditions that effect SHR movement.

Project 2: Effects of Abiotic Stress on Cell Signaling

The goal of this proposal is to determine how cell-cell communication is regulated under environmental stress and the consequences of altered communication on elemental distribution and development. Plants need to respond to and integrate numerous environmental signals during development. For example, nutrient levels in the soil have dramatic effects on root architecture and overall plant growth. Some metals, like Fe, Cu, and Zn act as essential nutrients at low levels, but at higher levels inhibit plant growth (1). Plasmodesmata (PD) are key players in this process, allowing for coordinated cellular responses to a diversity of environmental signals. Here we examine how 3 different abiotic cue: excess Fe, excess Cu and excess Zn effect PD mediated intercellular signaling. The student involved in this project would work with a graduate student to examine the response of mutant lines to abiotic stress.

Mia Levine

Project 1: Telomeres on a treadmill: causes and consequences of telomere protein evolution

Specialized proteins package genomic DNA into chromatin. This DNA packaging regulates gene expression, chromosomal inheritance, genome defense, and many other essential, strictly conserved biological processes. Nevertheless, many essential chromatin proteins evolve very rapidly over time. Even closely related species encode essential genes encoded by wildly different DNA sequence. The biological significance of this paradox—conserved cellular functions supported by unconserved molecular machinery—is poorly understood. The Levine Lab aims to address this paradox by studying the causes and consequences of evolution at chromatin proteins that package the very ends of chromosomes—the telomeres. Genes that encode telomeric proteins are absolutely essential for ensuring that two chromosomes don't fuse together end-to-end. Such chromosome fusions cause both DNA breaks during cell division and mistakes in chromosome inheritance. These aberrations are hallmarks of cancer cells. Using the model fruit fly, Drosophila melanogaster, we aim to test the hypothesis that rapid telomeric

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protein evolution is driven by so-called selfish DNA elements embedded in the ends of chromosomes. We will engineer fruit flies that encode the ancestral versions of the rapidly evolving proteins. To construct these genotypes, we replace the target gene with a version from another species. We will assay this "Frankenstein fly" for various phenotypes related to telomere function. This project offers the opportunity for two undergraduates (each working on a different telomere protein) to learn classical Drosophila genetics, evolutionary genetics, cell biology (including confocal microscopy), and molecular biology including cloning and quantitative PCR. Students with a keen interest cell biology or evolution are encouraged to apply.

CHEMISTRY

Ivan Dmochowski

Project 1: Designer proteins for biomaterials applications

An undergraduate will carry out protein mutagenesis, expression, purification, and characterization to advance several collaborative projects. Such projects include the design of stable protein-inorganic nanoparticle assemblies, the stable incorporation of therapeutic peptides or proteins within a larger protein assemblies, and the development of 2-D and 3-D biomaterials based on stable protein building blocks. For students willing to commit additional effort to this research, there will be opportunities to gain co-authorship on one or more publications.

Ideal applicant will have earned good grades in general chemistry lecture and laboratory courses, and have interest in the chemistry and/or biochemistry majors. All PURM students will receive hands-on mentoring from one or more graduate students in the Dmochowski laboratory.

Zahra Fakhraai

Project 1: Simulations of optical properties of nanoparticles *Rising Junior only*

We use finite difference time domain (FDTD) simulations to calculate optical properties of nanoparticles with various sizes and shapes. This simulation package basically solves Maxwell's relations in non-trivial geometries.

I am looking for an undergraduate student in Physics, electrical engineering, or Chemistry who is familiar with electromagnetism (familiar with the Maxwell's equations) and is able to understand

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the concepts behind the simulation. The simulations are fairly easy to perform, the data analysis requires basic Matlab skills, but we can train the student for those skills.

Feng Gai

Project 1: Fluorescence imaging of interactions between antimicrobial peptides and mammalian cells

An antimicrobial peptide (AMP) can cause cell death via two potential mechanisms, necrosis and apoptosis. Necrosis results in cell membrane rupture and loss of cellular content, whereas apoptosis leads to cell fragmentation and formation of smaller apoptotic bodies that still contain functional organelles. Currently, there is no easy method that can be used to directly visualize the mechanism of action of an AMP. Recently, we have developed a blue fluorescent amino acid that allows imaging of the location of any peptide that can bind to and/or penetrate into cell membranes, thus opening doors for many new biological studies, including the study of the action of AMPs. Students involved in this project will have the opportunity to learn a range of biochemical and biophysical skills, including, but not limited to, peptide synthesis, fluorescence spectroscopy, microscopy, data analysis, and image processing.

Specific responsibility: (1) synthesizing and purifying AMPs of interest, (2) investigating the mode of action of these AMPs using fluorescence spectroscopy and microscopy, and (3) analyzing data, summarizing and presenting results.

Madeleine Joullie

Project 1: Interdisciplinary approach for the development of novel latent fingerprint detection reagents

Although latent (hidden or invisible) fingerprint detection on paper is an integral component in forensic science, it remains as an uncharted territory for contemporary organic chemists. During the latter part of the 20th century, a wide variety of chemical reagents that react with amino acids present in natural skin secretions have been identified for this process. However, approximately over 50% of all fingerprints still escape detection due to limitations to sensitivity. Other formidable challenges include reproducibility of existing methods, probing complexity of the fingerprint residue, and development of cost-effective formulations. A robust method that utilizes a relatively simple reagent system is still in demand. This program is designed to address such challenges and is built on promising recent findings using 1,2-indanedione-based functionalized gold nanoparticles for the detection of latent fingerprints. Students will be exposed to synthesis, purification, and characterization of small organic compounds as well as exposure to direct application of the synthesized compounds in functionalizing gold

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nanoparticles. Most importantly, students will also gain experience detecting latent fingerprints on paper using the synthesized compounds. Additional unique benefits will include first-hand experience in being an integral part of a research project that is directly applicable to tangible societal issues. Successful completion of CHEM 241 and 242 is required. Completion of CHEM 245 is preferred. Students will be working under the supervision of Dr. Jisun Lee.

Project 2: Transition metal mediated organic chemistry synthesis: Curriculum development for undergraduate chemistry lab ***Rising Junior only***

CHEM 246: Advanced Synthesis and Spectroscopy lab is a required course for Chemistry majors, in which the course is designed to expose undergraduate students to up-to-date synthetic methods and graduate-level spectroscopy techniques and interpretations. We are currently undergoing curriculum update, and are looking for highly motivated, organized, undergraduate students who will help design and run experiments. In particular, transition metal-mediated organic synthetic methods will be explored. Students will get exposure to not only organic synthesis and analysis of small molecules, but also being a part of academic lab course development. Satisfactory completion of CHEM 241, 242, and 245 is required.

Students will be working under the supervision of Dr. Jisun Lee.

Marisa Kozlowski

Project 1: New Reaction Development

Development of new catalytic, oxidative fragment coupling processes. There is significant interest in these methods due to their use in the the pharmaceutical industry both for the synthesis of medicinal chemistry leads and in process development. In addition to conventional approaches to reaction optimization, high throughput experimentation techniques are utilized to identify leads and optimize processes.

Project 2: Statistical Model of Chemical Reaction Outcomes

Development of new computational models for reaction optimization based on statistical modeling. Electronic structure and quantitative structure activity relationship calculations are used. The results establish mechanistic pathways and the determinants for selectivity. This information in turn is used to predict the outcomes of modified systems with the aim of improving yield, selectivity, or scope.

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CLASSICAL STUDIES

Joseph Farrell

Project 1: Intertextual studies on the Fables of Phaedrus

Phaedrus composed more than five books of Aesopic fables in Latin verse during the first century BC. HIs work has been neglected for centuries, so that the most basic research tools needed by modern scholars simply do not exist. The purpose of this project is to study Phaedrus' relationship to earlier Latin poets by investigating quotations, paraphrases, and parallel expressions in his poetry. This sort of work has become much easier thanks to the existence of the Quantitative Criticism (QCL), an easily configurable, web-based (http://qcrit.org/#/home) pattern-matching program designed to study verbal relationships between Latin texts. My plan is to supervise one student, or possibly two, in an investigation of the relationship between Phaedrus and his predecessors by identifying verbally similar passages for further qualitative evaluation by the student and myself. If the investigation yields a significant number of parallels capable of literary interpretation, we would publish one or possible two papers in journals devoted to Classics and/or digital humanities.

COGNITIVE SCIENCE

John Trueswell

Project 1: Perceiving and Representing Events in the Mind and Brain

Students will learn how to design and administer perception experiments that explore how adults recognize events and simple causal interactions of objects. Students will be part of an active and vibrant lab interested in both perception and language. Experiments will ask adults, and perhaps children, to recognize and compare events depicting simple actions involving multiple people or objects. Some studies may involve eyetracking – the recording of eye movements to determine where people look as they perceive dynamic events. We are especially interested in students majoring in Cognitive Science, Linguistics or Psychology who have an interest in perception and language. Students should be comfortable working with computers.

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EARTH AND ENVIRONMENTAL SCIENCE

Douglas Jerolmack

Project 1: Experimental determination of moisture control on soil erodibility

A collaborative effort between Earth scientists and roboticists is underway, in which we are seeking to use a legged robot to assess the erosion susceptibility of soil in desert environments. Soil moisture exerts a strong but still not understood control on erodibility. As part of this larger project, we seek an undergraduate researcher with an interest in earth science, and a desire to help construct and execute laboratory experiments in support of studies of soil erosion. A custom-made rainfall-sandbox setup will be used to control the wetness of soil. Two different tests of soil erodibility will be made: (1) a small wind tunnel will determine the threshold wind speed for erosion; and (2) a robot leg will mechanically scrape the soil to measure the resisting force. Results from these two methods will be compared to both understand the response of soil to different forces, and also to assess the viability of using a legged robot to estimate threshold winds in field settings. Some laboratory experience is strongly desired - either in construction/machining, use of scientific instrumentation, or computer programming. The undergraduate will have the opportunity to learn relevant skills working side by side with graduate students, but it is expected that the student will gain sufficient independence to conduct experiments without supervision by the end of the summer. This proposal is part of a multidisciplinary project funded by the National Science Foundation, and there is a possibility for field work.

Irina Marinov

Project 1: Southern Ocean dynamics and its role in the global climate

Despite its critical importance for the global heat and carbon cycles, the Southern Ocean – the vast ocean surrounding the Antarctic continent – is the least understood region of the world ocean, particularly because of sparse observations and our incomplete understanding of high latitude processes such as sea ice dynamics. Here we propose to analyze a large dataset of 35 different state-of-the-art climate models ran as part of the last IPCC (Intergovernmental Panel for Climate Change 2014) model inter-comparison, to analyze the role of the Southern Ocean in the global modern climate. We plan to verify a set of hypotheses. (H1) Expected changes in sea ice, sea surface temperatures and salinities south of 60oS over the next century will trigger changes in the so-called Ferrell and Hadley atmospheric circulation cells, atmospheric energy budget and cross-equatorial heat exchange, ultimately influencing the position of the Intertropical Convergence Zone (the band of maximum rain on the planet) and rain patterns in the tropics and

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subtropics (e.g., Saharan desert). (H2) The circulation of the Southern Ocean will change in fundamental ways over the 21st century; this signal will propagate to the tropics and the North Atlantic via oceanic pathways, changing the ocean circulation at these other locations. (H3) Ocean circulation changes originating in the Southern Ocean will affect in major ways the storage of carbon and heat in the oceans by year 2100.

This is a data-analysis project that requires a minimal computational background. The student is expected to read some primary literature, learn how to read and visualize gridded climate data fields in MATLAB or python and to independently write codes for the required computations, which will involve statistical techniques (such as linear regression, correlation analyses and hypothesis testing) and mapping of the results. More advanced statistical knowledge and some natural science background ideal.

Project 2: The Southern Ocean and the Arctic: expected changes in a warming climate

Here we will use the newest generation of climate models to study and contrast the response of Southern Ocean and Arctic Ocean biology and physics to 21st century climate change. The Arctic is warming at a rate much higher than the Southern Ocean (SO); while the sea ice in the Arctic is disappearing at an alarming rate, SO sea ice has actually increased on average in recent decades. We plan to verify whether large differences between the physical responses to climate in these regions will translate into large differences in the biological responses and uptake of atmospheric CO2.

Phytoplankton (microscopic ocean plants) are responsible for 50% of photosynthesis on the planet – taking up atmospheric CO2 and resulting in massive CO2 storage in the oceans – and are the base of the ocean food chain. Oceanic physical properties (light; rate of mixing of deep, nutrient rich waters with the surface waters; sea surface temperature) known to influence phytoplankton growth will change in a future warmer climate. Here we will analyze the predicted changes in phytoplankton growth (biological productivity) and oceanic CO2 uptake over the 21st century in the Arctic and marginal sea ice regimes of Antarctica in a set of 15 climate models. We will analyze both natural variability and climate-driven, decadal trends in phytoplankton biomass and productivity, as well as CO2 uptake, and we will attempt to link changes in ocean biology to changes in oceanic physical properties in these two ocean regions.

This is a data-analysis project that requires a minimal computational background. The student is expected to read some primary literature, learn how to read and visualize gridded climate data fields in MATLAB or python and to independently write codes for the required computations, which will involve statistical techniques (such as linear regression, correlation analyses and hypothesis testing) and mapping of the results. More advanced statistical knowledge and some natural science background ideal.

Project 3: Incorporating biological evolution in climate models

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The global scale modeling of ocean ecology is in its infancy: only up to three distinct phytoplankton groups (out of hundreds in nature) are included in the current generation of state of the art Earth System Models (IPCC 2013), and without a potential to evolve under shifts in environmental conditions by being subjected to natural selection. Biological evolution thus cannot operate in today's most developed climate models. To fill in this void and answer questions such as: How do phytoplankton evolve and adapt to a changing climate, and what are implications for future climate predictions? How do changes in phytoplankton affect the ocean nutrient and carbon cycles and ultimately atmospheric pCO2, we want to connect the disparate fields of climate science and evolutionary biology. We will start from a theoretical framework for phytoplankton biological evolution, based on optimal resource allocation subject to eco-physiological tradeoffs – developed by collaborators Smith (2015) and Bruggeman (2010). We will start by understanding this model and running modifications of this model either in Matlab or Fortran. The ultimate goal is to insert this ecological module into a coupled ocean-atmosphere Earth System, enabling centennial prognostic simulations of the global ocean with the unprecedented yet crucial inclusion of biological evolution. We ultimately aim to understand the two-way interaction between evolving marine species and climate change. The student is expected to read some primary literature, learn how to read and visualize gridded climate data fields in MATLAB or python and to independently write codes for the required computations. Some computational and natural science background ideal.

Alain Plante

Project 1: Characterization of Anthropogenic Dark Earth soils

Most soils in tropical areas are highly weathered, causing them to be nutrient-poor. Anthropogenic Dark Earth (ADE) soils (like the terra preta found in the Amazon) are a notable exception. Formed by amendment with char, bones and other by-products of human and agricultural life for hundreds of years, these soils are extraordinarily fertile and rich in stable organic matter. So what is special about ADE that makes it so precious and fertile? We are seeking a motivated undergraduate researcher to perform a set of laboratory experiments to characterize the organic matter in a set of ADE and non-ADE soils from Ghana, Liberia and Australia. Experiments will include various physical and chemical methods to fractionate and extract organic matter, characterization of its chemical composition, and analysis of basic soil fertility properties. The goal of this work is to understand how these soils are capable of both storing organic matter over the long-term, while at the same time turning over carbon and nutrients to make them available for plant uptake.

Project 2: Laboratory incubations to assess soil organic matter stability

Microbial CO2 respiration of soil organic matter is a major component of the global carbon cycle, and has important implications for climate change. Laboratory incubations (basically

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putting soil in a jar and measuring microbial CO2 respiration) is a commonly used tool to assess the biodegradability of soil organic matter. A large number of studies have been published over the past few decades using this technique, but comparisons are difficult due to wide range of experimental design parameters used. For instance, incubation durations range from 6 days to 600 days. The outcomes of these incubations are also expressed using different forms and metrics. The objectives of this project are to perform an extensive literature review of laboratory incubation experiments. We seek to: 1) summarize the various experimental parameters, 2) synthesize the outcomes into a common form, and 3) provide prescriptive advice about optimal designs for assessing the biodegradability/vulnerability of soil organic matter stocks. These end products would represent an important contribution to soil science, biogeochemistry, and climate science communities, and be of very high value.

Lauren Sallan

Project 1: Rise of Jawed Fishes As a Result of an Ancient Mass Extinction

Jawed fishes, a group which includes humans and their ancestors, appeared abruptly 420 million years ago. Interestingly, this happened right after one of the 'Big Five' mass extinctions in earth history, the end-Ordovician, which wiped out a host of earlier invertebrates. It also happened amid a flourishing of jawless armored fishes, many with bizarre shapes never seen before or since. We seek to investigate whether jawed fishes, and therefore humans, are the result of new and short-lived opportunities presented by the loss of so many other species, and whether extreme, rapid diversification of their jawless relatives set the stage. This student will help apply 'Big Data' analytical approaches to a newly constructed database of vertebrates from the Silurian and Devonian (the age of fishes, 445-380 million years ago), borrowing methods from ecology, mathematical modeling and phylogenetic analysis. The student will learn important data science skills, including statistical methods, assembly maintenance of large datasets and coding in R or Python, as well as major features of vertebrate biodiversity and ancient ecosystems. Previous knowledge of spreadsheets, stats and coding is a plus, but all three are not required.

Project 2: Combining Living and Fossil Data to Track Fish Responses to Long-term and Rapid Global Environmental Change

Teleost fishes are today represented by 33000 species, ranging from seahorses to tuna to salmon to goldfish, and comprise more than half of vertebrate biodiversity. While fishes are commonly considered ancient, most modern teleosts abruptly appear around 150 million years, with reef fishes starting to diversify rapidly near the end-Cretaceous (65 million years ago). Still is only the first part of the story: most living teleosts have successfully survived the extinction that killed the dinosaurs, warming so extreme it left ocean deadlines and the onset of one of only two ice ages since the origin of vertebrates, which destroyed much freshwater and marine habitat. Yet, we do not know how they achieved this or responded to any of these major events. This prevents

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us from making predictions about the reaction of fishes to the current overfishing and climate crises. The issue is that there is no single database containing all known fossil fishes, nor are their interrelationships and origins accounted for. This student will help build a database of the types and ecologies of fishes over the last 65 million years using scattered descriptions in the literature. They will then help apply 'Big Data' analytical approaches to both fossil and living fishes to determine long-term responses to environmental challenged. This project borrows methods from ecology, mathematical modeling and phylogenetic analysis. The student will learn important data science skills, including statistical methods, assembly maintenance of large datasets and coding in R or Python, as well as major features of vertebrate biodiversity and ancient ecosystems. Previous knowledge of spreadsheets, stats and coding is a plus, but all three are not required.

Project 3: Do Ice Ages Suppress Fish Biodiversity?

Molecular studies and models have indicated that the ancestors of modern fishes should have first appeared in the Late Paleozoic (250-350 million years ago). However, such fishes have never been found. There is evidence that diversity declined among shelly invertebrates coincident with sea level fall during the Late Paleozoic Ice Age, destruction of marine habitat space by the formation of Pangaea, algal blooms and a marine deadzone covering half the Earth's single ocean. It is possible that fishes entered a period of stasis, slowing down their evolution to a crawl for 100 million years. This student will help apply 'Big Data' analytical approaches to a newly constructed database of vertebrates from the Late Paleozoic, borrowing methods from ecology, mathematical modeling and phylogenetic analysis. The student will learn important data science skills, including statistical methods, assembly maintenance of large datasets and coding in R or Python, as well as major features of vertebrate biodiversity and ancient ecosystems. Previous knowledge of spreadsheets, stats and coding is a plus, but all three are not required.

EAST ASIAN LANGUAGES AND CIVILIZATIONS

Ayako Kano

Project 1: War, Sex, and Belonging: Adaptation of Modern Japanese Fiction and Film

This project examines important novels and short stories from modern Japan that have been adapted to film. The project will be ideal for students majoring in, or interested in pursuing Cinema and Media Studies, Visual Studies, Comparative Literature, English, East Asian Languages and Civilizations, East Asian Area Studies, Gender Sexuality and Women’s Studies. The student will help me with background research and analysis, as well as scanning documents and extracting film clips. The project will consist of case studies that include some of the most

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significant authors and film directors of modern Japan, such as Mishima Yukio, Oe Kenzaburo, Murakami Haruki, Kurosawa Akira, Itami Juzo, Isao Takahata. By working on this project, students will gain extensive knowledge about Japanese culture and society, as well as hands-on experience with literary studies and film studies. Knowledge of Japanese language is helpful but not required.

ECONOMICS

Holger Sieg

Project 1: Fiscal Federalism

I am in the process of writing a book called Lectures in Fiscal Federalism and Urban Policy. The purpose of the book is to introduce advanced undergraduate students and master students to the topic. I am looking for a research assistant who could help me with following tasks:

a) some basic data analysis using existing data sets;

b) the design and writing of case studies related to specific policy interventions such the the introduction of term limits for welfare recipients or the time limits in public housing;

c) reviewing and summarizing key papers in the literature;

d) proofreading and editing.

Good language, analytical, computational and data skills would be helpful. Knowledge of latex would also be helpful, but is not essential.

I think working on this project would be a great experience for anybody interested in urban economics, urban policy or local public finance.

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ENGLISH

Jed Esty

Project 1: Declinism: Anglo and American

Declinism will be a short book (30-40 thousand words) addressing the major ideas and key rhetorical features associated with the specter of national decline in America, especially as viewed through the prism of Great Britain's own previous experience of national decline some 50-80 years earlier. The goal of the book is not just to establish a catalog or taxonomy of declinist tropes and concepts, but to thresh through the current media and scholarly languages for the decline or fading hegemony of a world power (America since the 1970s, say, but especially in the most recent few presidential elections) and to try to peel apart the real structural determinants of decline from the merely rhetorical contrivances of declinISM. Student researcher would be charged with roving over a pretty large terrain of references to American global/imperial/national decline in the media, policy, and academic literature, and helping me collate and categorize the resulting data into usable forms. Will require research agility and resourcefulness as well as a fairly high degree of intellectual initiative and judgment.

Michael Gamer

Project 1: Romantic Dramatic Networks

What can playbills and playtexts -- which customarily listed actors, characters, and secondary acts playing at a given theater on a given night -- tell us beyond their obvious advertising function? Among other things, they can help us to track the movements of actors, theatrical companies, and even the plays themselves. Where do plays go after their premier in London? How long before they hit the other parts of the kingdom? With what patterns? In this project, students will learn about the history of London and provincial theater as well as about new digital approaches to literary study. In other words, we will combine traditional close reading with computational and quantitative analyses. If the student wishes, s/he may also learn more advanced computer skills, including programming in the Python language and the fundamentals of database creation and management. No prior experience with these technologies is necessary - and we mean that. We're interested in training a student on the job in the history of this period's wonderful, insane theater (which saw the invention of the musical, the star system of acting, and other modern innovations). We also want to provide students with the kinds of computer skills that will enhance their research, not to mention be attractive to future employers. Students will be mentored on a daily basis with Scott Enderle, the digital humanities specialist in Van Pelt Library.

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Heather Love

Project 1: Description in Literature and the Human Sciences

I am completing a book project about practices of description in realist novels and in a range of research projects in the humanities and social sciences after WWII in the US and the UK. This is a comparative project in method--I am interested in the specific techniques that artists, writers, and researchers use to bring to life concrete social scenes. The period after WWII is characterized by an interest in everyday life and in micro-level observations of social interaction (gesture, spacing, comportment). I show that many of the same tools were used across disciplines and in the arts to capture the "small change" of social life. I have a particular interest in how these tools were used to understand relations of inequality: I look at several projects in which researchers analyzed the behavior of stigmatized or disempowered groups (urban poor, men engaged in anonymous sex acts, children with autism, etc), and consider the ethics of their observational approach. I need a student to help me with general research, researching related topics and reading articles. There are also archives at Penn that I need help with, since some of this research was carried out here in the 1960s and 1970s. There are no prerequisites, although an interest in both humanities (especially literature) and social science topics (especially anthropology and sociology) a plus.

GERMAN

Catriona MacLeod

Project 1: Paper Cuts in Nineteenth-Century Germany and Denmark

German Romantic authors and visual artists cut, glue, stain, and recycle paper; they generate paper cuts, collages, and ink blot poems in profusion, and even combine them in what are for their time striking new hybrid forms such as the picture books of fairy-tale author Hans Christian andersen (1805-1875) and medical doctor and poet Justinus Kerner (1786-1862). Crossing boundaries of genre and medium, and challenging the scale of monumentality, these nineteenth-century works are literally at the cutting edge. They foreshadow and reveal exciting parallels with avant-garde practices of the early twentieth century such as Picasso’s collages and Matisse’s paper-cuts, and with contemporary work in room-size silhouettes by US artist Kara Walker. I have already completed research on nineteenth-century women paper cut artists such as Adele Schopenhauer and Luise Duttenhofer, and in this phase of the book project would engage an undergraduate research assistant in: compiling a bibliography and image database for andersen and Kerner, as well as other Romantic authors and writers and modern practitioners and

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theorists of paper cuts such as Matisse and Walker. Familiarity with image research and German reading ability advantageous. This project would be a good introduction for a student interested in interdisciplinary word and image studies and material culture.

HISTORY AND SOCIOLOGY OF SCIENCE

David Barnes

Project 1: The Ganges Project: A Family Saga and the American Experience

In the summer of 1800, the U.S.S. Ganges captured two American ships off the coast of Cuba. The ships were carrying 137 enslaved Africans in violation of a law recently passed by Congress. The Ganges escorted the ships to Philadelphia, where the Africans were housed at the Lazaretto quarantine hospital. A federal judge declared them free and gave them all the surname Ganges after the ship that rescued them. The Pennsylvania Abolition Society assumed temporary custody of the Ganges Africans, and indentured them out as servants to local households and employers for periods of time ranging from four to ten years. Thus began the unusual saga of a very unusual African-American "family."

Today African-American families named Ganges are scattered around the Philadelphia area and the rest of the U.S., along with many other descendants of the original 137. This project aims to reconstruct the genealogies and life experiences of the original Ganges Africans and their descendants down to the present day. The student researcher will do extensive archival and genealogical research, using both original documents and online resources. Coursework and/or research experience in history is desirable but not required. Curiosity and a thirst for discovery are required.

Project 2: Building Bridges to Philadelphia's Immigrant Heritage

Understanding the experiences of immigrants and their contributions to American society has never been more important than it is now. Philadelphia's Lazaretto quarantine station (1799-1895), still standing today, provides a unique vantage point from which to examine the experience of new arrivals to the city and the region throughout the nineteenth century. The student researcher will hunt through local archives and online data sources in order to find information about the experiences of immigrants who began their new lives at the Lazaretto, and to identify and contact their present-day descendants. The research will inform events and publications designed to enhance public understanding of the American immigrant experience past and present, and to establish meaningful connections between 21st-century Philadelphians and their city's immigrant heritage.

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Coursework and/or research experience in history is desirable but not required. Enthusiasm and resourcefulness are required.

Etienne Benson

Project 1: Researching the Earth Without Leaving the Office: A History

The Earth sciences include disciplines like geology, oceanography, meteorology, and climatology that attempt to describe the physical form of our planet and the processes affecting it. These sciences have always been collaborative in nature, for the simple reason that it is impossible for any single researcher to observe - let alone understand - all of the phenomena that fall within its domain. For the same reason, there have always been people whose main contribution to the Earth sciences has been synthesizing the work of others. In recent years, however, a new kind of synthesizer has emerged - "data scientists," who draw on the data collected by others to identify patterns, create models, and propose new theories without ever collecting such data themselves.

Technological advances are one reason for the emergence of this new kind of scientist. Since the mid-20th century, there has been an incredible explosion in the amounts and varieties of data that are collected by satellite instruments, sensor networks, and citizen-science projects, much of which has been made publicly available. As a result, Earth scientists can make long, productive, and even illustrious careers out of mining such data for new insights. Instead of risking sunburn, sprained ankles, and worse in the course of collecting their own data in the field, they can now wait for the data to come to them. It is now possible - in theory, at least - to be a successful Earth scientist without ever leaving the office.

The emergence of new methods of data collection and new types of scientific research raises important questions about how we know what we know about the Earth - i.e., about the epistemology of the Earth sciences. Do data scientists know as much about the landscapes they model as the field scientists who have hiked and sweated through them for years or decades do? Do they simply have a different kind of knowledge - and if so, what are its advantages and disadvantages? How can non-scientists evaluate the strengths and weaknesses of such knowledge? How do we know whom to trust and what kind of research to support? Such questions become particularly pressing when urgent decisions must be made about how humans should relate to the environment, on scales ranging from the local (e.g., water pollution) to the global (e.g., climate change).

My research project takes a historical approach to these questions, drawing on a set of rich archives in Philadelphia and elsewhere that reveal dramatic changes in how Earth scientists have conducted their research and attempted to make that research relevant to policy decisions since the mid-20th century. As my research assistant on this project, you would assist in identifying,

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gathering, organizing, analyzing, and interpreting such sources. An interest in understanding how science relates to society - and specifically how scientists have sought to address environmental problems - is welcome, but no experience is necessary.

Project 2: The Shocking History of the Bug Zapper

In 1990 the British artist Damien Hirst exhibited a new work at a warehouse show in London. Titled "A Thousand Years," it consisted of a large glass case divided into two sections. In one section, a large white box contained larvae that were continuously metamorphosing into adult flies. In the other section, which was connected to the first by a small hole, an electric insect killer - an "Insect-O-Cutor" - was suspended above the rotting head of a cow. Over the course of the exhibition, the bodies of the electrocuted flies accumulated on the floor around the cow's head. According to Hirst, this literally shocking - and to many viewers, disgusting - piece of art dramatized the cycle of life and death. It did so by incorporating a technology, the bug zapper, that had progressed from being a curiosity in the early 20th century to being a crucial, if usually invisible, part of the infrastructure of modern life by the end of the 20th century. By the time of Hirst's exhibition, bug zappers were not only being used to surreptitiously reduce fly populations in restaurants, bakeries, and other sites of food production and consumption, but they were also being deployed in suburban backyards and patios in the hope - usually illusory - of eliminating mosquitoes and other biting insects. One of the less-commented-upon aspects of Hirst's piece is that it took this largely invisible technology and placed it at the center of the viewer's attention.

Beyond its role in contemporary art, this very mundane - and, indeed, disgusting - technology has much to tell us about changing standards of hygiene, comfort, and leisure over the course of the twentieth century. As Hirst's piece suggests, it also has something to tell us about how humans have understood their place in the cycle of life - both our vulnerability to sickness, injury, and death, which we share with all living beings, and our extraordinary power over the lives and deaths of other living beings on this planet. My research on the history of the bug zapper is part of a broader project on the role that technology plays in our changing relationships to animals and nature. Who invented the bug zapper? When and why did it become widely used? How did its use reflect - and change - our understandings of nature, health, leisure, and comfort? As a research assistant for this project, you would work closely with me to identify, collect, and synthesize historical sources that illuminate this history, including newspapers articles, business archives, and other sources from across the 20th century. An interest in history and the environment is welcome, but no experience is required - just attention to detail and enthusiasm for piecing together a historical puzzle.

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Beth Linker

Project 1: America's Forgotten Epidemic: Poor Posture and the Twentieth-Century Promise of Health and Beauty

In the 1990s, American critics and academics became scandalized by the revelation that just decades earlier, many of the nation's elite schools took nude posture photographs of all incoming freshman. Some claimed that the photos were a thinly guised form of pornography, while others argued that it was a vast eugenic experiment run by pseudo-scientists with a hidden master-race agenda. In actuality, for much of the twentieth century many Americans believed that they were living through a posture epidemic, with an estimated 80 % of U.S. citizens exhibiting faulty form. Fitness manuals, "posture-perfect" clothing and shoes, as well as ergonomic furniture abounded in this period. This project will reopen the so-called Nude Posture Photo debate with the intent to offer a deeper historical consideration of the practice, seeking to understand twentieth century posture experts on their own terms. The research assistant for this project will work with me to uncover this history by looking at early twentieth century popular women's and health magazines, university newspapers, digital archives, and advertisements for posture devices and furniture. The best candidate for this position will have good library skills, careful note-taking ability, and a background and interest in gender and health, as well as the history of twentieth century science, body, and popular culture. HSOC, STSC, and history majors preferred. Experience with digital technology a plus but not required.

LINGUISTICS

Jianjing Kuang

Project 1: The effect of musicality on linguistic tone perception

Pitch is used for both singing and speaking. All languages use pitch to distinguish either lexical meanings or sentence meanings. However, a lot of people are born tone deaf, which means they have difficulties in hearing pitch differences. This disability usually affects those people's ability to sing and play musical instruments. However, amusia individuals can still perfectly acquire either tonal (e.g., Mandarin) or non-tonal languages (e.g., English). In this project, we would like to know how musicality can affect people's linguistic tone perception. In particular, for people who are not so good at hearing pitch, how they overcome the disadvantages in pitch perception and successfully figure out the intended linguistic tonal targets. This project includes running several experiments on both tone perception and musicality scores. Students will be responsible for recruiting participants, running trials, and recording and analyzing data, for which training

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will be provided. Depending on interest and ability, students may also get involved in other aspects of research, such as experimental design and programming tasks.

Project 2: How children code prosodic structures

Similar to music, speech also has distinctive patterns of melody and rhythm, which is called "prosody". The meaning of a sentence is not only determined by the words we choose, but also determined by the melody we use to articulate (i.e., prosodic structures) the sentence. For example, when using a falling melody, "John likes Mary" is stating a fact; but if the same word sequence is produced with a rising melody, then "John likes Mary" becomes a question. The speaker either looks for confirmation of the fact (i.e., "is it true that John likes Mary?") or expresses doubts (i.e., "I don't think/I can't believe John really likes Mary"). Prosodic structures can also help highlight important information in the sentence. For example, for the sentence "I bought two cups of coffee", when the word "two" gets stressed, the sentence means "it is TWO cups of coffee, not three"; when the word "coffee" gets stressed, the sentence emphasizes "it is coffee, not tea". Children have to master prosodic structures to become a competent language user of the community. In this project, we want to understand how children use prosodic structure in their speech, and when their speech becomes adult-like.

In this project, we will annotate and analyze spontaneous speech of both children and adults in several languages. Students will have the opportunity to learn to apply several state-of-the-art speech technologies to extract features from large corpora, and quantify the patterns of prosodic structures. Students who are interested cognitive science and have good computational skills (e.g., familiar with matlab, python, Praat) are preferred. The experience gathered from this project will be especially helpful for students who are interested in pursuing a career in speech technology.

Gareth Roberts

Project 1: Experimental language games

This is an experimental project that will be run in the Cultural Evolution of Language Lab. In this project, participants will learn artificial languages and use them to play communicative games with each other. By placing different social and communicative pressures on them, we will observe how the artificial language adapts and changes.

The student will be involved in all aspects of the project. The primary duties will be recruiting participants, setting up and running trials, debriefing, recording data, reporting problems, and so on, for which training will be provided as necessary. Secondary duties include data analysis and software programming (here the precise details will depend on the student's experience and interests, and there is a very good opportunity to develop programming and analysis skills).

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There is also an option, if the student is interested, to design a new experiment (in collaboration with me, and possibly grad students) to be run in the lab.

(Please note that most participants in the experiments run in the lab are Penn undergraduates. Therefore, a more detailed description of the project cannot be provided here. If you have questions, please contact me for more information!)

John Trueswell

Project 2: Language Learning in Children and Adults

Students will learn how to design and administer experiments that explore how people learn the meanings of words in their native language. Students will be part of an active and vibrant lab that visits area preschools to study young children's language learning abilities. These children participate in simple word learning studies, some of which include the recording of eye movements as they hear speech referring to pictures on a computer screen. Other studies examine how adults learn words and grammar, as if these were either new words in their native language or words from a second language. This project is supported by the National Institute of Child Health and Human Development. We are especially interested in students majoring in Cognitive Science, Linguistics or Psychology who have an interest in language and the mental representation of language in the mind. Students should be comfortable working with young children and comfortable working with computers.

PHILOSOPHY

Susan Meyer

Project 1: Beyond Contempt: Political Dialogue and Disagreement in the age of Trump

Consider a much-reported conversation between an angry Trump supporter and a participant in the Women's March on Washington:

Trump supporter: "If you people had jobs, you wouldn't be out here doing this mess!"

March participant: "Bitch, it's Saturday." (NY Magazine 21 Jan 2017)

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Now consider a different Trump supporter, 29 year old Erin Cunningham, who "would like to engage with people her age whom she disagrees with about politics, but feels shut out of the conversation as soon as a liberal peer accuses her of being racist… 'You're not going to convince me by yelling at me and telling me I'm a bad person,' she said, and later added, 'I don't think I can be racist if I used to date people of the opposite races'." (NYT 20 Jan 2017)

Erin feels like she is in the same position as the marcher in our first example—attacked and falsely accused, rather than being given a respectful hearing.

My project is to develop sample dialogues (modeled on the dialogues of Plato or Hume) that provide concrete guidance and examples of the sort of constructive, issues-oriented conversation that might convince someone like Erin to change her mind. Public discourse today is sorely lacking in such models.

I seek 2 assistants who are adept in social media (a way to solicit the input of people like Erin), unafraid of rigorous argumentation, and interested in philosophical questions about racism and justice.

Quayshawn Spencer

Project 1: A Radical Solution to the Race Problem

In 2002, population geneticists discovered that the human species can be divided into five populations of people according to how similar their genomes are. These populations are Africans, East Asians, Eurasians, Native Americans, and Oceanians. This result caught the attention of many race scholars because of how similar these groups look to certain folk racial classifications. So far, there is no consensus among philosophers of race about whether this human population division is a division of people into races according to how American English speakers use 'race'. Some philosophers have argued that given what races are, by definition, these populations cannot be races. Other philosophers have argued that these populations are races given what races are. This research project provides a novel answer to this fifteen-year old problem: they're all right. What I will argue is that the term 'race' is ambiguous in American English, and thus, this biological division of people is and is not a racial division given different ways that American English speakers use 'race'. I call this new view racial pluralism. The research output will be a book, called A Radical Solution to the Race Problem. The research assistant will help me with background reading, collecting evidence for the premises of arguments, and revising chapters. So, the assistant will receive considerable training in reading comprehension, critical thinking, logical reasoning, and creative thinking. The assistant should be competent in basic logic and enthusiastic about the metaphysics of race.

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Michael Weisberg

Project 1: Community-Based Ecology in the Galápagos Archipelago

The Galápagos Archipelago is a series of 18 large volcanic islands located off the coast of Ecuador. Famously the inspiration for Darwin's ideas in On the Origin of Species, the islands remain an important focal point of biological work due to their relative isolation, their large number of endemic species, and their unique and fragile ecosystems. Unfortunately, due to the increasing popularity of ecotourism, the growing local population, and changes in global climate, these islands face many ecological challenges.

This project attempts to address some of these challenges. While other organizations are also attempting to save local species and habitats, our research group is focused on the community of galapageños. Despite living in one of the most biologically sensitive areas on the planet, the full-time residents are largely unaware of the environment in which they live. Prior attempts at environmental mitigation in the islands have taken the form of protocols imposed on the community, hence these attempts are often seen as annoying interferences with daily life. Research in our labs and elsewhere suggests that this is a mistake; the kind of scientific and ecological literacy required for action crucially involves an appreciation of the nature and character of the scientific research process. Even more importantly, community leaders have emphasized repeatedly to us that the most profound, ecologically positive changes have come when the youth of the Galápagos have been engaged in ecological matters.

Besides the Penn team, you will work together with local leaders and community members in a series of projects that address pressing issues where ecology, climate change, poverty, and educational inequality intersect.

PHILOSOPHY, POLITICS AND ECONOMICS

Cristina Bicchieri

Project 1: Changing social norms: Combating open defecation in India

Working with the Bill and Melinda Gates Foundation, we have recently started a massive three-year project designed to provide a clear understanding of the underlying social factors that support open defecation and barriers that prohibit latrine use in rural and urban India.

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Open defecation (OD) is a serious public health issue in India, and nearly 500 million people practicing in the country alone. OD contributes to many serious health issues, with India reporting the highest number of diarrheal deaths in children under-five in the world. It is not simply an infrastructure limitation either, as many latrines that have been built in affected areas go unused.

Using household surveys and mobile telephone responses, we will explore how beliefs, expectations, and cultural factors may contribute to OD's persistence. Specifically, we will use a social norms framework to attempt to distinguish between different kinds of socially motivated behavior. Additionally, we will measure and analyze the structure of target communities so as to better understand what sort of intervention would be most effective. Our measurements and analyses will ultimately be used to advise on and design an intervention to most effectively encourage OD abandonment.

This is an exciting project in terms of both its scope and importance. An interested student will have opportunities to research relevant aspects of Indian culture, help construct professional surveys to assess factual beliefs, social expectations, and community structure, and/or help analyze data.

Project 2: Betting and Match-Fixing in Professional Sports

Corruption in general but in sports in particular is a ubiquitous issue in both amateur and professional sports, especially in the form of match-fixing. With higher stakes involved, such distortions create negative externalities not only on the individual but also on the aggregate level, such as loss of media interest, and erode the inherent principle of fair and competitive sports. Betting on sports is a steadily growing business (the market volume for regulated sports betting worldwide is estimated at $58 billion per year) and has become an integral tool in making money off fixed matches. Recently, investigations showed evidence that match-fixing has run rampant in the tennis sport for years and triggered a general discussion regarding the extent to which match-fixing has generally soaked through sports.

We are in possession of a huge one-of-a-kind data set on betting volumes across 50 different sports and hundreds of leagues that allows us to study this topic for the first time and trace suspicious instances of betting behavior. The data spans a time period of 9 years and provides detailed betting data (including the betting volume). The purpose of this PURM project is to capitalize on this data and help the PPE team to look into issues including but not limited to match-fixing. For students, this is a great opportunity to analyze big data, investigate suspicious patterns, and ultimately work at the forefront of crime analysis. Prior knowledge in working with STATA (or a related program) and econometric knowledge is helpful.

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PHYSICS

Vijay Balasubramanian

Project 1: From photons to objects: machine learning and visual processing in the brain

How does the brain learn to identify object categories? This is one of the deep questions in visual neuroscience. The goal of this project is to apply machine learning techniques to massive simultaneous recordings from retinal neurons, to gain insight into how the cortex might learn to identify abstract objects from retinal responses to light in the world. To this end, I seek a student with strong mathematical and computational skills to participate in a research program to elucidate how the brain constructs abstract and invariant representations of shapes and objects from the sensory data impinging on the retina. The student must be a fluent programmer. Knowledge of machine learning techniques is a plus. The student will collaborate with postdocs and graduate students in my lab to analyze simultaneous recordings from thousands of retinal neurons responding to natural movies. He or she will apply machine learning techniques to this data to attempt to teach a neural network to learn higher order visual representations of shapes and objects. The aim is to compare these learned representations with recordings made from deep layers of animal brains.

Project 2: Adaptive Molecular Sensing in The Olfactory and Immune Systems

The binding of molecules with each other is the basis of life at every scale from viruses to the whale. Some such processes have a lock-and-key character, where particular molecules guiding behaviors are sensed by specific receptors. But organisms dealing with open environments face more complex molecular sensing challenges. For example, the olfactory system must identify and discriminate odor mixtures drawn from an enormous space of volatile molecules (perhaps a million types) using very few odor receptors (O(1000) in mammals). Similarly the adaptive immune systems of vertebrates and bacteria are tasked with “sniffing out” potential threats drawn from diverse and evolving pathogen populations. How can bounded systems and circuits process and represent molecular spaces that are much larger than themselves and that are varying in time? They must adapt to the structure and statistics of the space that they are trying to sense. The goal of this project is to develop and test theories of such adaptive sensing. To this end, I seek a student with strong mathematical and computational skills to participate in a research program that explores the functional organization and dynamics of the early olfactory and adaptive immune systems. The student must have a strong grasp of differential equations and linear algebra, and be a fluent programmer. The student will collaborate with postdocs and graduate students in my lab to build theoretical models of molecular sensing in the olfactory and immune systems, and to test the models with experimental data.

Project 3: Statistics of Natural Scenes and the Perception of Visual Textures

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Human beings have a remarkable ability to detect the presence, however weak, of some kinds of visual patterns and correlations in images. However, behavioral studies show that other kinds of visual patterns are very hard to see, even when they are mathematically prominently in an image. Why are some patterns easy to see, while others are practically invisible? This project will seek show that visually salient patterns are highly variable across natural image patches and thus highly informative about the world, while the "invisible" patterns contain less information about the structure of natural images. To this end, I seek a student with strong mathematical and computational skills to participate in a research program exploring the functional organization of the visual system. The student must have a strong grasp of linear algebra, and be a fluent programmer. Knowledge of image processing, machine vision, and machine learning techniques will be helpful. The student will collaborate with postdocs and graduate students in my lab to explore the statistical structure of natural images and the relation between these statistics and the perceptual salience of different classes of visual texture.

A. T. Charlie Johnson

Project 1: Nano-enabled Lyme Disease Diagnostic

This work will be done in collaboration with Prof Dustin Brisson (Biology). The student will be mentored by a postdoctoral fellow and a phd student.

We have demonstrated [1] that nano/bio sensor systems have the potential for use in the detection of Lyme disease and other infectious diseases. The ultimate goal of this project is to create a multiplexed array of protein-graphene biosensors that is capable of simultaneous detection of multiple protein biomarkers of Lyme disease using human bodily fluids (blood, urine, etc.). The student will be involved in all aspects of the project including graphene synthesis, sensor fabrication, and sensor array testing. Course work or experience in Physics, Chemistry, Biology, or Computer Programming is very desirable but not essential for participation in this project.

[1] Lerner, M. B.; Dailey, J.; Goldsmith, B. R.; Brisson, D.; Charlie Johnson, A. T., Detecting Lyme Disease Using Antibody-Functionalized Single-Walled Carbon Nanotube Transistors. Biosensors and Bioelectronics 2013, 45, 163-167.

Project 2: Scalable Synthesis of Two-Dimensional Materials

The student will be mentored by a postdoctoral fellow and/or a phd student. The work will involve collaboration with colleagues in Chemistry and multiple SEAS departments.

Imagine a material as large as a sheet of paper but only 1/100,000 the thickness of a piece of hair. Examples include graphene (a single-atom thick layer of carbon) and a growing family of 3-atom thick materials known as metal dichalcogenides. These materials can exhibit a variety of

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remarkable electronic and mechanical properties, making them suitable for integration into new sensor concepts, wearable devices and systems, and many other applications. In this project we will explore the properties of devices based on two-dimensional materials with sizes as small as 20 nm to test their suitability for use in next generation computer chips as well as new types of biochemical sensors. Course work or experience in Physics or Chemistry, is very desirable but not essential for participation in this project.

Project 3: Electronic Nose System Based on Carbon Nanotubes

The work will involve collaboration with colleagues from the Ovarian Cancer Center and the Penn Vet Working Dog Center, among others. The student will be mentored by a postdoctoral fellow and/or a phd student.

We have developed technologies that duplicate and extend our ability to see, hear, and touch, but for odor detection and analysis, biological systems (e.g., dogs) remain the "gold standard". The ultimate goal of this project is to develop an electronic nano sensor system capable of similar feats such as the detection of disease by the odor of human blood samples or monitoring of air pollution in real time. Our sensor concept is based on a carbon nanotube technology invented in our lab. Course work or experience in Physics or Chemistry is very desirable but not essential for participation in this project.

Eleni Katifori

Project 1: Investigating the topology of the coronary vasculature

The healthy function of the various organs in the human body, and consequently of the body as a whole, depends in part on the topology and function of the vascular system that permeates them. In fact, specific modifications in the veins and arteries in the body are known in some cases to be precursors of various diseases.

In this project we will use network theory to investigate if certain characteristics of the coronary vasculature correlate with disease. The student will use computer algorithms already developed in the Katifori lab, as well as commercial software to quantify the topology of the blood vessel network in images obtained via coronary angiograms. Then, through statistical analysis of graph theoretical metrics, the student will be looking for potential correlations of network characteristics with coronary disease.

The project is interdisciplinary and requires some programming knowledge, as well as physics, and an interest in biomedical applications.

Project 2: The topology of the network of semantic relations in the English language

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The words of the english language can be loosely grouped together based on their semantic meaning: such is the function of a thesaurus. The same word can appear in multiple groups, establishing this way a network of word interrelations that carry information about concepts and ideas. For example, the word bread links to the word nourishment, with in turns links to the word meal etc, which are all related to food.

In this project the student will be using the database WordNet (https://wordnet.princeton.edu/wordnet/) to study the network of word relations. As a first step, the student will learn how to use and navigate through the WordNet database and subsequently be responsible for data extraction and data analysis. The student will be using network theory to quantify aspects of the network and study some of its properties. Eventually, we hope to develop tools that relate the topological characteristics of the lexicographical network to how ideas and concepts are connected to each other.

The project requires programming knowledge and an interest in computational linguistics.

Joshua Klein

Project 1: Atmospheric Neutrino Studies with the Sudbury Neutrino Observatory ***Rising Junior only***

Work on data analysis from the Sudbury Neutrino Observatory. The goals are developing energy reconstruction of these interactions, as well as studies of neutron production by the neutrino events. Coding skills, and in particular experience with C++ or the data analysis package root, is necessary.

POLITICAL SCIENCE

Ryan Brutger

Project 1: International Negotiations, Leader's Strategies, and Public Opinion

Do you enjoy following current events and foreign policy? Are you interested in how people learn about politics and develop political opinions? If so, you may be interested in this PURM project. My research focuses on international negotiations, such as those involving the Iran-nuclear deal, the Syrian peace talks, and the Trans-Pacific Partnership. I am particularly interested in analyzing the strategies leaders use in negotiations and how members of the public react to the negotiations (or don't). I am looking for students to assist me in identifying

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interesting international negotiations, writing brief summaries on the negotiations, and helping conduct full case studies of a select few negotiations. This project will require students to be organized in their research process and is best suited to those who are excited to read and analyze media, government, and historical reports on a wide range of international negotiations. Coursework in political science or international studies is helpful, but not required.

Daniel Hopkins

Project 1: Understanding Attitudes toward the Affordable Care Act

Since its passage in 2010, the Affordable Care Act (ACA) has been a highly visible and contentious policy. Whether through insurance coverage, its cost, taxes, or other avenues, the law affects millions of Americans. However, Americans' attitudes toward the ACA have generally been quite stable since its enactment. This research project involves the collection and analysis of varying types of data on politicians' and voters' views about the ACA. We will couple extensive survey research (including several novel surveys conducted for this project) with press releases, campaign advertisements, tweets, television coverage, and other information to better understand the rhetoric surrounding the ACA as well as Americans' opinions. To carry out this multi-method research project, we will analyze public opinion from a wide range of vantagepoints, including the use of traditional surveys and automated analyses of Twitter and other online content. Key questions include to what extent people with pre-existing health conditions, high-deductible plans, high or low incomes, insurance via Medicaid, or insurance via the ACA exchanges think differently about the ACA. Are Americans' attitudes toward the ACA simply a function of partisanship, or do they vary with people's concrete experiences with the law? Students can expect to assist with identifying and condensing relevant research, as well as assisting with data collection, management, and analysis. Members of the research team will also help with writing up the study's results. Experience with statistical analysis (especially using R), political science, Python or other programming languages, or Spanish are helpful but not strict prerequisites.

Project 2: Research Partnership with City of Philadelphia

The Philadelphia Behavioral Science Initiative--http://phillybsi.org/--is a partnership between the City of Philadelphia and researchers at the University of Pennsylvania and elsewhere. Its goal is to improve the performance of city programs and outreach through the use of insights from the behavioral sciences, including social psychology and behavioral economics. At present, the initiative is working on a range of projects, such as improving outreach to low-income Philadelphia residents about the Earned Income Tax Credit and the city's bike share program as well as reducing litter in our public spaces. Members of this research team will help with surveying relevant research literature, planning randomized experiments, implementing those experiments in conjunction with City officials, analyzing the resulting data, and writing up the

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outcomes for academic and popular audiences.This will be a hands-on research experience--and an opportunity to see how research can make an immediate difference in people's lives. Students participating will have the opportunity to work with leadership in City Hall as well as researchers here at Penn to implement experiments in a real-world setting. Experience with statistical analysis, social psychology, behavioral economics, field experiments, Python or other programming languages, or foreign languages including Spanish are helpful but not strict prerequisites.

Marc Meredith

Project 1: Assessing Electoral Integrity

Donald Trump claims that 3 to 5 million people voted illegally in the 2016 election. Other people claim that millions of voters were suppressed from voting in 2016 by policies, like voter ID, that were adopted to help protect the integrity of elections. In this project, students will work with me to help collect, process, and analyze data that help us assess empirically which, if either, of these claims appear to be true. Duties will include identifying new sources of data, managing the collection of data from county and state election offices, and using computer software to process and analyze the data. Previous experience with Microsoft Excel is necessary and previous experience with Stata, R, or another statistical software program preferred.

Dawn Teele

Project 1: Understanding the Gender Gap in the Era of Women's Suffrage

The admission of women into the voting public was one of the most remarkable social and political transformations of the last century. While only three countries extended full national voting rights to women prior to 1900, by 2000, in nearly every country where men could vote, so too could women. But the question that looms large is whether expanding the electoral franchise to women made a dent in electoral politics.

Previous attempts to understand women’s political behavior have been limited either by their geographical scope (considering primarily the United States), or by their temporal reach (focused on the period, after 1950, when survey and polling data became available). Our hope is to improve on both of these dimensions by collecting fine-grained election returns data for a large set of countries in order to generate estimates about women’s political preferences and the effect of including women on electoral outcomes after the vote was won.

Theoretically, we suggest that the prior seminal finding of a “traditional” gender voting gap from the post WWII era to the 1970s likely reflects the fact that in many of today’s advanced

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industrial economies women worked less and were less politically active in the middle of the century than in the first half or the latter third. Thus, contrary to the current literature's predictions about the direction of the female vote, we argue that given women's high levels of economic participation in the early twentieth century, the importance of left and working class coalitions for winning the vote, and parties' mobilization strategies, women's suffrage should have led to a leftward swing in political power.

The undergraduate researcher can help in three ways depending on interest. 1.) conducting literature search and review relevant to the countries we study (including the US, UK, Norway, Sweden, Argentina, Chile, Canada, and Belgium). 2.) searching for and compiling data on voting patterns and voter turnout, or census data for the countries we study. 3.) helping to analyze data we have already collected if the student has good programming skills.

This project is joint with Mona Morgan Collins, currently a fellow with the Alice Paul Center and a post-doc in the department of political science.

Project 2: Women in Parliament and the Politics of Abortion

The quest for reproductive rights, and in particular the right to abortion, is a hallmark of the left-feminist policy agenda. Liberal abortion laws can contribute to women's autonomy by allowing them greater control over the timing and spacing of births, and legal access to abortion can decrease maternal mortality and reduce teenage fertility. These social-justice arguments are met on the right by similarly moral claims – that the right to life applies to the unborn, beginning at conception. To put it mildly, preferences over abortion diverge wildly with other social cleavages such as ideology and religious beliefs. Using an original dataset of abortion liberality, which tracks both expansions and contractions in abortion rights, and new measures of the gender and ideological distribution of power in national legislatures from 1950-2010, I examine the relationship between partisanship, gender within parties, and abortion policy.

An undergraduate researcher could help in two ways 1.) collecting and cleaning data related to women in parliament in several of the countries for which I still lack information (Argentina, Austria, Belgium, France, India, Japan, Mexico, Netherlands, Uruguay, and others). 2.) helping to conduct literature searches and case studies on reproductive rights histories for any of the countries for which the student has a particular interest.

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PSYCHOLOGY

Delphine Dahan

Project 1: Coordination in conversation

Language enables people to talk about entities in the world. However, the same entity can be referred to using many different linguistic expressions. For instance, if I want to talk about Jim Kenney, I can use his full proper name, ‘Jim Kenney’ if I believe that my addressee is also familiar with Philadelphia’s politics and that this shared knowledge is mutually known of each other, i.e., in in their so-called ‘common ground’. Other expressions (e.g., ‘Philadelphia’s new mayor’) do not presuppose this mutual knowledge. The choice of expression also reflects the perspective the speaker adopts and assumes makes sense for their addressee, as illustrated in the differences between using ‘the mayor’, ‘the man with the red tie’, 'the neighbor', or ‘Jim’. Finally, the expression can be definite, as exemplified by the examples above, or indefinite (e.g., ‘a man’). The use of a definite expression may convey the presupposition that the entity can be uniquely identified by the addressee because of mutually shared knowledge (e.g., ‘the mayor’, ‘Jim’). Conversely, the use of an indefinite expression conveys the fact that the referent is not unique or specific (yet).

How do people decide which referring expression to use when talking about a specific entity with their addressee when engaged into a conversation? On the one hand, people may largely rely on what they estimate to be in their common ground (because of past interactions or because a knowledge that people from the same community are believed to share) and leave it to their addressee to ask for clarification if necessary. On the other hand, people may prefer to make fewer assumptions about what is mutually shared and instead establish it together, relying then on this recent experience in subsequent mentions. The project examines how different people adopt different strategies and which, if any, demographic variables (age, sex, highest level of education attained) may predict people’s behaviors.

The student will collect and analyze data from a corpus of conversations taking place between people engaged in a referential communication task. In this task, participants play a matching game while sitting on either side of a table separated by an opaque barrier blocking access to each other’s faces and work-space. The setting is analogous to holding a phone conversation. Each participant is given an identical set of cards; each card displays the image of a black complex geometric configuration on a white background, which can be seen as the silhouette of an object (a so-called ‘tangram’). One participant is assigned the role of director and instructs the other, the matcher, about which cards to select from their set in order to reproduce a series of sequences printed on a booklet that only the director can see. The game continues for several rounds, with participants exchanging roles along the way. Each card appears in multiple

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sequences. A video-recording of the participants' workspace allows the experimenter to assess whether or not the matcher chose the intended card and thus, provides an objective measure of communication success. The verbal exchanges between the participants are recorded and later coded and analyzed. Forty such conversations have been collected. The project will consist of coding the referring expressions that participants used throughout their conversation and infer how people use common ground in conversation.

Robert DeRubeis

Project 1: Developing Methods for Personalized Mental Health

Depression is one of the leading causes of disability in the developed world. While various therapies for depression are effective, there still remains room for improvement. "Personalized medicine", the term for using patient characteristics to guide treatment decisions, can improve therapy efficacy. Our lab has developed the Personalized Advantage Index (PAI) where multiple variables are weighed in the prediction of what would be, for a patient with features, X, Y, Z, etc., the treatment most likely to benefit him or her. Now exciting machine learning approaches have boosted the power of our approach even further.

Students will have the opportunity to learn about therapies for depression, research methodology, data collection and preparation, as well as gain extensive skills in statistical analysis (machine learning, multiple regression, etc.) and computer programming. A background in elementary statistics or computer programming is preferred, but not necessary as training can be provided. Students will be working in collaboration with Dr. DeRubeis and other members of the lab on projects involving treatment selection.

Geoff Goodwin

Project 1: Why do people care about future generations?

Why should people feel moral concern for future generations? This question has been of considerable interest to philosophers, and it is of practical relevance to a number of pressing existential threats to humanity, including climate change, the lingering possibility of largescale nuclear or biological warfare, the possibility of a world-ending asteroid strike, or the possibility of runaway artificial intelligence. However, experimental psychologists have not yet explored this issue in depth. Do ordinary individuals care about future generations, and if so, why?

These questions break apart into two quite separate concerns. First, do (and should) people care about the welfare of future generations? Second, do (and should) people care about the existence of future generations? From a philosophical perspective, answering the first question is

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relatively straightforward. If future generations are guaranteed to come into existence, then their welfare matters just as the welfare of currently existing people matters, and this can be accounted for on any standard ethical account of why we should show concern for other people. But, what if future generations are not guaranteed to exist? Imagine that we know that a giant asteroid is on course to strike earth and destroy all of humanity in 100 years from now, and there is nothing we can do about this. Do we care about this? Should we? and, why?

We hypothesize that people do indeed care about issues of this sort, but for reasons that are outside those usually considered relevant. Utilitarian philosophers, such as Peter Singer, argue that people should care about the extinction of future generations because of the opportunity costs involved – the extinction of humanity would prevent an enormous amount of human happiness from coming about. However, we suspect that this argument does not capture why ordinary individuals care about the non-existence of future generations. Instead, we think that people's main concern has to do with the cessation of the larger human project, or story, of which they are a part, and to which they feel connected. We hypothesize that it is this sense of psychological connectedness (or embeddedness) within this larger project, and the sense of meaning that comes from being part of this narrative, that most distinctly drives people's desire to see humanity continue.

We plan to explore these issues with novel studies that will first probe subjects' open-ended reactions to prompts regarding the destruction of humanity, and that will subsequently ask more focused questions about reasons to care about such events.

The undergraduate student who would work on this project would ideally have a background in moral philosophy and/or moral psychology, experience working with Excel, and ideally, some background in statistics. This student's responsibilities would include literature search and review, stimulus generation, and the design, implementation, and analysis of web surveys designed to explore the questions described above. This student will gain exposure to the fields of moral and environmental psychology. We will also teach research skills such as designing studies (using Qualtrics), data collection (MTurk and pen-and-paper), data analysis (SPSS and/or R), and conducting literature reviews in preparation for writing research reports.

Project 2: Optimism about the climate: a double-edged sword?

Imagine the world's natural environment 100 years into the future. What does it look like?

You might imagine that if things continue on their current trajectory, the earth will have become a much less hospitable place. Sea levels will have risen, with many coastal cities flooded and uninhabitable, sewerage systems destroyed and diseases flourishing. With climate change running rampant, the weather will be less predictable; many growing seasons around the world will be shorter, with lower crop yields leading to famine and food insecurity. The world's glaciers and arctic ice will be almost completely gone, many plant and animal species will have become extinct, and the survival of humanity hangs in the balance.

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On the other hand, you might imagine a more optimistic trajectory. World leaders have managed to agree on emission reduction targets, leading to a dramatic slow-down in global warming. Almost all countries are completely powered by renewable energy, and sustainable agricultural practices and prudent resource management ensure that famine and water scarcity are disasters of the past. New technologies have emerged that remove carbon from the atmosphere, and which are capable of reversing previous runaway warming trends. New technologies have also enabled humans to live in ways that no longer disrupt the natural environment. Finally, through increased cooperation, many previously endangered species have been brought back from the brink of extinction.

Dispositional optimists are probably more likely to imagine the latter scenario; dispositional pessimists the former. How do these different visions relate to an individual's likelihood of taking pro-environmental action? In this exploratory study, we will investigate the effects dispositional optimism (or pessimism) have on the likelihood of taking pro-environmental action. We expect that people high on dispositional optimism may be less sensitive to the threats posed to the environment by climate change, and may also be more confident in the emergence of technological solutions to our current predicament. Reduced risk perception and increased confidence may in turn lead to less perceived need (and motivation) to personally take pro-environmental action. However, optimists may also feel more efficacious with regard to the environment – that is, they may feel that they have greater control, and that their actions will make a difference – which in turn may lead to greater motivation to take pro-environmental action. Thus, in the present study we seek systematically to explore both these possible effects of optimism on pro-environmental behaviour.

The undergraduate student who would work on this project would ideally have an interest in environmental issues, a background in social or moral psychology, experience working with Excel, and ideally, some background in statistics. This student's responsibilities would include literature search and review, stimulus generation, and the design, implementation, and analysis of web surveys designed to explore the questions described above. This student will gain exposure to the fields of moral and environmental psychology. We will also teach research skills such as designing studies (using Qualtrics), data collection (MTurk and pen-and-paper), data analysis (SPSS and/or R), and conducting literature reviews in preparation for writing research reports.

Harvey Grill

Project 1: Individual differences in obesity proneness. Do differences in response to satiation signals predict who will gain more weight on high fat diet?

Obesity is a disease and a major world health issue. Two thirds of Americans are obese or overweight while 33% of the adults living in the same environments remain lean. Clearly there is a genetic and biological basis for obesity expression that is important to understand. Our lab is

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interested in investigating what accounts for these individual differences in obesity proneness. This study will explore individual differences in responses to satiation signals (gastrointestinal signals that inhibit further eating, e.g. cholecystokinin, gastric distension) and how that may correlate with future weight gain using a rat model. Here, we hypothesize that individuals that are less responsive to post-meal satiation signals will have a greater propensity for weight gain. Follow up studies will be performed to determine the neural mechanisms that mediate these effects. This project will involve peptide injections; behavioral analysis (e.g. food intake measurements) and ELISA and follow up studies may involve molecular techniques such as qPCR and Western blotting.

Project 2: Role of central glucagon like peptide (GLP-1) and oxytocin (OT) receptor signaling in food reward

In the face of the current obesity epidemic, it is important to understand at the neuroendocrine level the control of food intake and weight gain. Overeating is driving the elevated rates of obesity and overweight and what is driving overeating is the availability of tasty, energy dense, and cheap food. Liraglutide, a GLP-1 analogue, was recently FDA approved to treat obesity. However, the neural substrates involved in mediating the food intake reduction by this drug are not fully known. Recent studies have suggested that GLP-1 reduces food intake at least in part by acting on the brain to reduce food reward. Oxytocin has been in the news of late as a variety of clinical studies are investigating its effects on food intake as well as other functions. Experiments within this project will examine brain regions (e.g. paraventricular nucleus of the thalamus, PVT for GLP-1; ventral tegmental area VTA for OT-R) and their contribution to the control of food reward. This project will involve central GLP-1 or OT agonist microinjections and extensive behavioral analysis using paradigms such as conditioned place preference, progressive ratio responding, and reinstatement of food seeking. The project will also involve the use of gene knockdown techniques (e.g., shRNA) for both OT-R and GLP-1R to address the role of these receptors expressed in particular brain regions on food reward and food seeking behaviors.

Paul Rozin

Project 1: How people in different cultures (languages) divide up the food world

The food world, and distinctions made among possible foods, are essential to survival. The most basic distinctions are between safe and dangerous foods, and between foods of animal versus plant origin. It is generally true of languages that single words are used to describe major, important categories. But in English there is no single word in English for either plant or animal foods. Meat does not include eggs or dairy, and in most uses, does not include seafood. Similarly, the English words dividing plant foods into vegetables, fruits, and grains is vague (corn is really a grain, tomato a fruit) and it is not clear where nuts belong. Through interviews of native speakers of a range of different languages, particularly different languages, such as

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Turkish,Mandarin, and American Indian languages will determine how different languages categorize the world of food. We will look for fundamental similarities and differences. The student will help to design the protocol, do the interviews, and analyze the results. Callie Holtermann has expressed an interest in this project.

Project 2: Protecting the memories of very positive past events

Many people have positive memories of enjoying Bill Cosby shows, but now he is judged to be a person who preyed on women. Does this current assessment contaminate prior positive memories of Cosby shows, so that these memories are now unpleasant, or can these past experiences be protected. This situation arises with disgraced persons, and also on the break up of many marriages. We want to explore when old positive memories can be protected, which results in happier memories. We believe that there are both situational determinants of this, such as whether the offender was active as an offender during the prior positive period. There are also probably personality factors; some people may be better at protecting memories than others. Through a survey of American adults who have had these experiences we hope to understand how and when memory protection works; we think it is generally better for well being to be a memory protector. Student will be involved in all phases of this work.

Project 3: What is moral disgust

The emotion of disgust is often associated with a certain class of moral violations, while anger is associated with others. We are interested in what determines whether disgust or anger dominates. Our hypothesis is that crimes that involve bodies and bodily damage are more likely to evoke disgust, whereas white collar crimes will elicit minimal disgust and much more anger. We will describe a wide range of moral violations in a survey, and ask Americans how much they are disgusted and angered by them, using both the words and facial expressions of each emotion. In this way, we hope to better define the nature of moral disgust. The student will do some reading in the area, help to design a set of moral violations, arrange this in a survey and launch it for an American adult on-line sample. A second round of studies, informed by the first will probably be necessary

Alan Stocker

Project 1: Perception: Learning to compensate perceptual biases ***Rising Junior only***

Human visual perception is often biased. Recent studies suggest that these biases might not represent a deficit of the visual system but rather represent the visual system's attempt to optimally infer the stimulus using prior belief information (top-down). We have previously run psychophysical experiments that allowed us to characterize these priors. The goal of this project is to test whether humans are able to overcome these biases by feedback, and to establish how

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such potential learning might change their prior beliefs over time. The project involves the adjustment of the existing visual psychophysical experimental setup to incorporate feedback, recruiting subjects and running the experiment, and finally processing and analyzing the data. The project is best for students who want to gain experience in setting up and running psychophysical experiments. Knowledge of the programming language 'Matlab' is an advantage but not required. The student will have the opportunity to learn more about Bayesian models of perception.

Project 2: Vision: Image statistics and their role in forming prior beliefs

Prior beliefs about what we are expecting to see strongly affect our ways of actually seeing. With this project, we would like to explore the degree to which these prior beliefs are reflecting the intrinsic statistical structures of natural scenes. Specifically, we will focus on the temporal correlations between images (frames) in movies of natural scenes and explore how they would be able to explain the well-known temporal dependencies of visual perception, e.g. perceptual illusionary after-effects (such as seeing a red square after having stared on a green square for an extended period of time). The project will consist of establishing a database by recording movies of natural scenes emulating best possibly the natural stream of visual information humans are exposed to. In a second phase, careful and elaborate statistical analyses of the database will reveal the spatiotemporal structures of these natural movies. In a last step, the project will investigate whether these statistics are predictive of the temporal dependencies in human perceptual behavior. The project is best suited for a student with some (not necessarily extended) background in image processing and statistical analysis. Interest in some field work is also essential. Knowledge of the programming language 'Matlab' is an advantage but not required. The student will have the opportunity to learn more about Bayesian models of perception.

Project 3: Computational Neuroscience: Efficient coding in populations of neurons
Rising Junior only

The brain can be thought of -- amongst other things -- as an information processing device that has to allocate its limited resources (e.g. number of neurons and available metabolic units) in a way that information about the world is represented in an efficient way. This theoretical project addresses the question how a population of model neurons can achieve such efficient coding. The project will start simple, considering a single population of model neurons encoding a scalar variable that follows some distribution. The goal is to explore different information theoretic and other measures defining optimal solutions for adjusting some free parameters of the model neuron population (such as individual tuning widths, firing rates, spontaneous activity) under simple noise constraints. This is in many ways an unsolved problem. The project is best suited for a student with a good mathematical background, and who has the interest to learn more about information theory and its application in neuroscience. The student will be introduced to the different state-of-the-art methods and approaches addressing this question and will have the opportunity to develop with his mentor new methods and approaches.

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Sharon Thompson-Schill

Project 1: Human learning and memory

This research project examines how perceptual systems are involved in learning and remembering conceptual information. A behavioral component of the project tests whether the sensorimotor systems responsible for planning and producing physical movements are involved in comprehending action-related information during sentence reading. A neuroimaging component examines how learning abstract properties (e.g. monetary or social values) of visual stimuli influences neural responses in related areas of the brain (e.g. those involved in vision or decision-making) using functional magnetic resonance imaging (fMRI).

The student working on this project will gain a deeper understanding of research in perception, cognition, and neuroscience. Furthermore, this work provides opportunities to hone academic and technical skills that can be tailored to the student's specific interests, including (1) how to design scientific experiments that address theoretical hypotheses about cognition, (2) programming in different software languages (coding in Matlab and/or Python), and (3) data acquisition with fMRI and analyses of such brain data (e.g. MR data processing, statistics, classification with machine learning algorithms, network analyses). A student with prior coursework in psychology, cognitive science, neuroscience, programming, basic statistical analyses, and/or fMRI is preferred, however, is not necessary. Applicants should be comfortable with both Mac and PC computer systems.

Project 2: Conceptual combination

This research project examines how perceptual systems are involved in learning and remembering conceptual information. A behavioral component of the project tests whether the sensorimotor systems responsible for planning and producing physical movements are involved in comprehending action-related information during sentence reading. A neuroimaging component examines how learning abstract properties (e.g. monetary or social values) of visual stimuli influences neural responses in related areas of the brain (e.g. those involved in vision or decision-making) using functional magnetic resonance imaging (fMRI).

The student working on this project will gain a deeper understanding of research in perception, cognition, and neuroscience. Furthermore, this work provides opportunities to hone academic and technical skills that can be tailored to the student's specific interests, including (1) how to design scientific experiments that address theoretical hypotheses about cognition, (2) programming in different software languages (coding in Matlab and/or Python), and (3) data acquisition with fMRI and analyses of such brain data (e.g. MR data processing, statistics, classification with machine learning algorithms, network analyses). A student with prior coursework in psychology, cognitive science, neuroscience, programming, basic statistical

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analyses, and/or fMRI is preferred, however, is not necessary. Applicants should be comfortable with both Mac and PC computer systems.

RELIGIOUS STUDIES

Megan Robb

Project 1: Highlighting Women's Voices in South Asia

This project will involve collecting previously unpublished correspondence of Muslim, Hindu, Jain, Christian, Buddhist, and Sikh women in South Asia and among the South Asian diaspora. The long-term goal of this project is to collect and catalogue an online archive of women's hand-written and typed letters spanning the 18th to the 20th centuries - offering a research resource to researchers seeking to access a range of women's voices in a range of South Asian religious traditions that remained previously hushed in the archive. The research will involve work in the Library of Congress, British Library, National Archives in Delhi, National Library of Pakistan, and of course at the University of Pennsylvania; the work will also involve establishing trust and connections with individual families with substantial family records across Pakistan and North India. If funding permits, the research assistant will accompany the project leader to the British Library in London and the Bodleian Library in Oxford for an archival field trip. The research assistant's responsibilities will include assisting the project leader in identifying potential correspondence holdings in each of the above archives; collecting and cataloguing online archival holdings for analysis by the project leader; managing correspondence to librarians and correspondence collectors in South Asia; organizing an online database of the correspondence; assisting in the writing of a grant to fund an accessible, online archive of the correspondence records in cooperation with the University of Pennsylvania libraries. The project will involve conversations about analysis of translations, thematic organization of the correspondence, and institutional partnerships to encourage further collection and research. The research assistant will be encouraged to design their own independent research project using the correspondence they have assisted in collecting. Prerequisites include having taken at least one course in Religious Studies, with preference given to Religious Studies majors or minors, and the student should have a demonstrated interest in South Asia and/or Gender Studies. Mentorship will also be offered by research partner at the University of Oxford, Dr. Sneha Krishnan.

Project 2: Media and Religion: Urdu Newspapers and Muslim Publics ***Rising Junior only***

The product of the research project is a book entitled "Print and the Urdu Public", exploring the links between the development of Urdu newspaper conversations and the solidifying link between Urdu and Muslim identity. This project will involve archival work at the University of

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Pennsylvania, Library of Congress, the library of Royal Holloway, London, and the library of Cambridge University, England. Prerequisites include an intermediate knowledge of Urdu. The research assistant will assist in adding to an existing archive of Urdu language newspapers from a variety of archives, will assist with translations if possible, and will define their own research project for the summer that makes use of the archival material. Candidates will ideally have taken courses in Religious Studies, but students from the South Asian Studies Department are also encouraged to apply. This project would be ideal for a student with existing skills in Urdu, who would like to improve their grasp of the language through translation work, and who would like exposure to archival work in both the United States and in the UK.

SLAVIC LANGUAGES

Julia Verkholantsev

Project 1: Language as Fossilized History: Myth, the Etymological Method and Medieval Historians

My project deals with myths of origin in medieval and early modern chronicles and historiographic sources of Europe. “Myths of origin” are legendary stories that describe the genesis of ethnic groups, their social order, their names, and the names of places that they inhabit. I investigate the passages that include mythical narratives in order to understand what motivated medieval authors to view them as “historical material.” Many of these myths are built around etymological interpretations of names of people and objects because medieval historians believed that connections between similarly sounding words provided a mystical link to the otherwise unknowable reality of the distant past. For example, the 15th-century historian Pulkava was convinced in the divine origin of his native Bohemia because he derived its name from the Slavic word Boh, which means ‘God’. I am thus interested in the role that language and linguistic theories played in the validation of the veracity of myths and turning them into “history”.

This project is appropriate for a student with particular interest in history, linguistics, and working with primary sources. The research assistant will read chronicle accounts in English or other language in which s/he is proficient, identify relevant narratives and assist in preliminary data analysis. To work on this project, the research assistant needs to possess good analytical skills, be attentive to detail, and – preferably – possess an advanced knowledge of a foreign language (e.g. French, German, Latin, Spanish, Italian, or other).

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SOCIOLOGY

Amada Armenta

Project 1: Immigrants and Justice: Gendered Understandings of Crime and Policing among Latino Immigrants in Philadelphia

Although decades of empirical research finds no relationship between immigrants and crime, the presumed criminality and "illegality" of immigrants is a regular part of American political discourse. "Illegality" is also central to understanding immigrants' social vulnerability. Unauthorized immigrants, the majority of whom are Latino, are at high risk of wage theft, robbery and street crime because of the real and perceived perception that they will not report their victimization to authorities. This qualitative project will rely on in-depth and group interviews with Latino immigrants, local stakeholders, and police officials, to examine crime, policing, and victimization among Latino immigrants with precarious legal status in Philadelphia.

Ideal candidates will be fluent in English and Spanish. Duties will include transcribing and coding spanish language interviews, conducting literature reviews, attending public events and conducting fieldnotes, and helping manage data collection

Hans-Peter Kohler

Project 1: Surviving the Epidemic: Families and Well-Being, Malawi 1998--2020

Research assistance is needed for a new project on "Surviving the Epidemic: Families and Well-Being, Malawi 1998--2020". The summary of this project is as follows. Across Eastern and Southern Africa (ESA), a remarkable cohort is reaching middle and older ages: those who have survived the AIDS epidemic. Some were infected with HIV, but everybody in this cohort was affected by HIV. Nobody could escape an epidemic that was devastating for both its health and social implications, and one that struck hard in a region also dealing with poverty, famines, and basic uncertainties of life. Were the survivors of this cohort just lucky? What promoted survival and resilience in such a terrible context, and what influenced health and well-being among the survivors and their families? How is present demographic change, health, well-being and economic development in ESA shaped by the experience of the epidemic and by the strategies used to survive the epidemic? These and related questions about "Surviving the Epidemic" (STE) will be studied by exploiting an unusually rich data source: the Malawi Longitudinal Study of Families and Health (MLSFH) cohort, 1998--2020.

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The motivation to expand, publicly-release and analyze the MLSFH until 2020 is multifold: (a) The MLSFH 1998--2020 will provide a unique opportunity to investigate questions about STE, an opportunity not available from other ESA data. (b) The MLSFH 1998--2020 will also be exceptional in allowing researchers to understand how the epidemic and the strategies for STE employed by individuals and families continue to shape the epidemiological and demographic transitions in ESA. (c) The end of the epidemic will almost certainly not mark the end of global health crises (an example at the time of this submission is the considerable concern about Zika in the Americas), and we need to better understand the mechanisms of how low-income country citizens cope with such crises.

The Specific Aims for the MLSFH 1998-2020 therefore include: Aim 1: Collect and publicly-release new MLSFH data from 2016--20 for (a) surviving MLSFH respondents and their families, (b) children of surviving and deceased respondents, and (c) migrants, with an expected N(surveyed) ≈ 6,300 plus data on 1,200 deceased respondents. The topics to be covered include wellbeing, mortality and morbidity, family and household dynamics, social capital and networks, physical and mental health, household production and consumption, and intergenerational relations. Aim 2: Using the MLSFH 1998--2020 and diverse methodological approaches for longitudinal data ranging from ethnographic methods to econometric structural equation modeling, analyze the determinants of STE by identifying the factors, social contexts and individual/household behaviors influencing survival, resilience, and well-being among MLSFH respondents, their children, and other family members. Aim 3: Analyze the consequences and lasting imprints of STE on (a) physical/mental health and non-communicable diseases among surviving adults and children of survivors and non-survivors, (b) fertility, investments in children and human capital in families differentially affected by the epidemic and STE, (c) migration and remittances, and (d) coping capabilities for new shocks and crises.

Research assistance would involve various preparatory work for data collection, review of existing literature, and analyses of existing data to inform data collection. Students are expected to produce a substantive academic paper related to this research. Students with appropriate qualifications and interests might also have the opportunity to join fieldwork in Malawi during the summer 2017, but this is not required for this summer project.

Dorothy Roberts

Project 1: Interracial Marriage and Racial Equality in Chicago, 1937-1967

I am conducting an interdisciplinary book project on interracial marriages in Chicago from 1937 to 1967. I inherited from my father, an anthropologist at Roosevelt University, numerous boxes containing original interviews he conducted in Chicago during this period with hundreds of interracial couples, as well as notes, articles, and other related materials. I am using this archive to write a book exploring the role interracial marriage played in the changing racial politics in

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Chicago from the perspectives of the couples. How did interracial couples experience and understand their marriages in relation to Chicago's "color line" and the intensifying challenge to the racial order? Students will help me to organize and analyze the archive on interracial marriages and conduct additional research related to this topic. Students will learn how to conduct and analyze original research, including ethnographic, legal, and archival data. This position would be especially helpful to students interested in careers in law, sociology, anthropology, Africana Studies, and history. It requires excellent organizational and research skills, creative thinking, and care with original documents.

SOUTH ASIA STUDIES

Deven Patel

Project 1: Sanskrit Literature and the Making of a Digital Sanskrit Text

The project focuses on a translation and digital text of a very important anthology of Sanskrit poetry. The student will have a very good opportunity to learn about Sanskrit poetry, translation practices, learning the most commonly used Sanskrit script (Devanagari), the learning of a Unicode font for entering Sanskrit text into Roman transliteration, work with aural recordings of Sanskrit poetry. There are no prerequisites for this research position. The student will be responsible for: entering the text in Unicode font into the computer, reading (and offering responses about) translations of Sanskrit poetry.

Project 2: Aesthetic Reception in Different Media: A Study of Possibility of the "Peaceful" Emotion in Art

The student would help research and offer thoughts about a current project that explores the differences that emerge in the reception of art and, especially, emotional content in art, through divergent mediums. The research project specifically looks at theories of art reception in Sanskrit poetics -- specifically the possibility of a "peaceful" emotion -- and contemporary critical theories of art-reception. Students would be doing original research of critical theory on the subject and also learn how to structure and edit a research paper. No prerequisites except an interest in art and media.

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Dental Medicine

ORAL MEDICINE

Thomas Sollecito

Project 1: Emergency department utilization prior to visiting the dental school emergency clinic

The recent rapid increase in hospital emergency department utilization for dental-related problems in the U.S. has been raised as a concern in the literature. Dental schools may play a pivotal role in providing dental emergency services; However, little data exists from the dental prospective. The purpose of this study is to investigate: 1) the prevalence of ED utilization for dental problems prior to visiting a dental school emergency clinic and 2) predictors of ED visits factors.

The student will learn applied statistics, epidemiology and study design. It is anticipated that the student will produce a peer-reviewed publication under close guidance by the mentor, who has successfully provided the opportunity for a number of students to present in many professional national meetings. This project is suitable for not only premedical/dental students, but also all students who are interested in improvement of the healthcare system.

Primary mentor: Takako I. Tanaka, DDS, FDS RCSEd.

Project 2: Temporomandibular joint disorders in the pediatric population

Temporomandibular joint disorders (TMD) are often multifactorial and require an inter-disciplinary approach. Increasing numbers of patients with TMD pain in children and adolescents, particularly as a part of psychosomatic pain, are anecdotally well-recognized among dental/medical professionals today; however, effective treatments for the pediatric patients are not well-established and can be challenging. The aim of this study is to develop algorithms for the management of TMD in this population.

This project involves a retrospective chart review. The student will learn the basic principles of human subject research, how to review the medical/dental literature, and gain an appreciation for the application of basic science to clinical research. The goal is that the student presents at a professional meeting and produces a publication under close mentoring. Students who are considering pre-medical/dental studies or clinical research are encouraged to apply.

Primary mentor: Takako I. Tanaka, DDS, FDS RCSEd.

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Project 3: Coordinated inter-professional care needs for patients with the head and neck cancer

Optimal risk assessment prior to delivering chemotherapy or radiation therapy for cancer patients is critical for health-care professionals. To minimize side effects of these therapy and achieve the best treatment outcome, comprehensive oral evaluation and counseling are often required for patients with the head and neck cancer before initiation of medical therapy. The University of Pennsylvania Health System is unique in that such evaluations are routine and well streamlined among different types of health care professionals, including oral medicine, oral & maxillofacial surgery, otolaryngology, and radiation oncology. The purpose of this study is to evaluate the effectiveness of these collaborative efforts in our health care system, and further promote patient safety.

This is a prospective study including a survey of cancer patients. Not only pre-medical/dental students, but all students who are passionate about clinical experience at a hospital will be suitable for this project. The student will be trained in accessing and viewing some clinical data under the mentor's supervision. It is expected that the data will be presented at a national meeting and produce a publication in a peer-reviewed journal.

Primary mentor: Takako I. Tanaka, DDS, FDS RCSEd.

PREVENTATIVE AND RESTORATIVE SCIENCES

Fusun Ozer

Project 1: Effect of Addition of Gantrez Copolymer (PVM/MA) on the Physical and Antibacterial Properties of Orthodontic/Denture Resin Polymethyl Methacrylate

Orthodontic removable appliances often include acrylic resin materials that are used for additional properties such as stability and additional mechanical movement. However, these extra surfaces allow for bacterial deposits and growth. Those undergoing orthodontic treatment already have a higher risk for cavities due to plaque accumulation from poor diet, suboptimal oral hygiene and often lack of motivation. Therefore, it is important that orthodontic appliances contain some antibacterial properties.

It has been reported by previous studies that a copolymer of methylvinyl ether (PVM) and maleic acid (MA) (commercial product Gantrez) can reduce plaque retention by inhibiting initial bacterial adhesion to enamel surfaces via electrostatic repulsion and release of calcium ions. The PVM/MA copolymer turns from a free carboxylic acid monomer form (Gantrez-97) into an anhydride form upon polymerization (Gantrez-AN). The aim of this study is to measure the

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effects of the addition of the Gantrez copolymer (maleic acid) into orthodontic/denture resin material (poly methyl methacrylate). Surface hardness (SH), Compressive strength (FS), Water sorption, antimicrobial and bacterial adherence properties, will all be evaluated. It is hypothesized that with the addition of the Gantrez, while the antimicrobial properties of denture material will be enhanced, the physical properties of the resin material will be the same. Positive results with Gantrez containing denture based materials will increase the oral health care of the orthodontic patients who are using removable appliances.

In this study, the student will be working under close supervision of the faculty mentor she or he is working with. They will arrange their working hours together according to the student's and mentor's schedule. Student will be responsible for all the sample preparations and will be trained on the test methods they will be using for the study. They will also help with the data collection.

RADIOLOGY

Muralidhar Mupparapu

Project 1: Radiology Information Systems, Database Management, and Workflow Development In a Dental Radiology Setting

Radiology Information Systems (RIS) are essential for the overall workflow in the Radiology department. An RIS streamlines patient registration, image acquisition, interpretation, and reporting. Such systems improve work efficiency and make patient management easier. Traditionally, most dental schools within US and Canada depend on some form of Picture Archiving and Communication System (PACS) that is suited for dental needs. In addition, the schools also invest in Electronic Health Records that integrates the PACS system. Although this marriage is adequate for the basic needs of the dental patient management, a lack of functionality for advanced imaging modalities leaves much to be desired and puts an undue strain on human resources. This research project looks into database management of existing saved patient data (remains coded for HIPAA purposes). The division of Radiology seeks to implement a new radiographic information system called INFINITT(R) on a trial basis. The student selected for this research project will be trained within this new software environment and will be trained by the IT department of the Dental School to be able to access the remote data as well as the local data. With appropriate permissions, a work flow algorithm will be developed which could be used for future patient care. The selected student will be given training in dental terminology, dental anatomy and pertinent Electronic Health Record management for Radiology purposes. Although it is not essential for the student to be savvy in any database management or programming skills, it is nice to have some knowledge in the computer applications, MS word, Photoshop, Adobe Illustrator. Pertinent training will be given by the IT department if needed.

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This project is primarily developed for aspiring or current dental students who should be knowledgeable in the field of radiographic image data management as this can be easily adopted to or implemented in a dental office after graduation.

Project 2: Longitudinal Study of individualized radiographic examinations at North American Dental Schools: 2002-2016 experience

The Food and Drug Administration(FDA) developed guidelines for dental radiographic examinations in 1987 and the American Dental Association adopted these guidelines for all dental practitioners. The main purpose of these guidelines is to reduce the radiation doses to general population and maintain the diagnostic ability of dental radiographs by selecting appropriate dental x-ray images.

Kantor ML (2002) researched the utilization of these guidelines and compared the level of utilization of the guidelines and trends in the implementation of selection criteria among North American Dental Schools. He also compared the trends from 1977 to1988 and then 1988 through 1993 and 1998 when he and other researchers published data on this topic. Since his last publication in 2002, there was no additional data on this topic.

This research is intended to continue this research further by surveying the current trends in imaging among US and Canadian dental schools to see the level of compliance with the FDA/ADA guidelines. The student researcher will be involved in developing appropriate questionnaires for this research, contacting all the US and Canadian Dental Schools telephonically or electronically to gather data on the research topic. At the conclusion of the research, the student researcher will help Dr. Mupparapu in reviewing and analyzing the data. The results will be presented as an abstract at the annual meeting of the American Academy of Oral and Maxillofacial Radiology (AAOMR). The student researcher will also assist Dr. Mupparapu in writing a manuscript for the Journal of Dental Education (JDE).

References:

Kantor ML. Longitudinal trends in the use of individualized radiographic examinations at dental schools in the United States and Canada. J Dent Edu, 2002.

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Design

ARCHITECTURE

Daniel Barber

Project 1: Environmental Histories of Architecture

As historians confront the geophysical and epistemic challenges of climate change and other environmental threats, the forces seen to condition the historical development of architecture are being re-conceived. The history of design methods for solar house heating and climate control, of materials that reduce embodied energy, and of technologies that encourage efficiency are of increasing relevance to historians. The period from the 1930s to the 1960s, before mechanical systems of heating, ventilation and air conditioning (HVAC) were widely available, is of especial interest, as numerous architects explored design methods to manage seasonal climatic changes or to provide comfortable living and working conditions in extreme locales.

Environmental Histories of Architecture intends to develop a rigorous and thorough database documenting these building strategies. the database will collect those buildings most engaged with environmental issues. The project will also develop means to analyze this data in order to offer new conclusions about historical patterns of architectural-environmental experimentation. The hope is that the database, while an important teaching tool at Penn, will also be made available to other researchers - likely through the existing platform of the Mellon-Funded Global Architectural History Teaching Collaborative, of which the primary faculty sponsor is a founding member.

Student work will include examining histories of architecture to identify the importance of environmental considerations. Student will scan images, adjust them in Photoshop, manage the database, and use the Timescape visualization tool to communicate results. Some familiarity with the history of 20th century architecture could be useful, but is not necessary.

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CITY PLANNING

Stefan Al

Project 1: Adapting Cities to Sea Level Rise ***Rising Junior only***

Sea level rise is impacting cities worldwide. Aimed as a resource for communities that will need to invest in flood management infrastructure, this project will provide a graphical catalogue of best practice resilient strategies. Going against standard engineering solutions, it argues for approaches that are nature based, integrated with the public realm, and sensitive to local conditions and the community.

Students' duties: Making diagrams and assisting in analyses. Students would have to be familiar with graphic design software such as Adobe Illustrator, and preferably modeling software such as Rhino.

Project 2: Sustainable and High-Density Urban Form ***Rising Junior only***

While much attention on reducing carbon emission has been paid to alternative fuels and electric vehicles, better urban design is an important yet overlooked opportunity. The urban form of cities can play a substantial role in the reduction of greenhouse gas emissions. First, energy consumption for transportation drops when urban form gets more compact and dense. Moreover, the shape and orientation of urban blocks can help optimize solar exposure, reducing residential energy needs for heating. This project aims to analyze existing high-density urban blocks in order to propose urban design guidelines that can promote compact cities with optimal environmental performance and a high quality of life.

Students' duties: Making diagrams and assisting in analyses. Students would have to be familiar with graphic design software such as Adobe Illustrator, and preferably modeling software such as Rhino.

Megan Ryerson

Project 1: Safety Implications of Travelers Switching from Air to Ground

Since 2008, US airlines have systematically reduced the number of flights transiting through airports in small and medium-sized metropolitan areas. My research found that up to 17% of the daily traffic on interstate highways (depending on location) is due to "leaked passengers" driving to a large, hub airport, (e.g. traveler from Harrisburg driving to Philadelphia airport to enjoy better service and lower fares). Conventional wisdom tells us that flying is statistically safer than driving; however, it is unclear if "leaked passengers" consider safety in their travel plans. In this

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study, the student would research crash rates on highways over time and space, with the goal of modeling how changes in airline services might impact the overall safety of the intercity transportation system.

For this exciting collaboration between Engineering, Design, and CHOP Center for Injury Research and Prevention, we are looking for an undergraduate student who will be responsible for 1. Analyzing frequency and severity of traffic accidents and mapping these accidents over time and space; 2. Studying the air transportation system trends and mapping the interactions between airports and highways, 3. Modeling crash frequency and severity on corridors of interest, 4. Summarizing methods and results in a technical report.

The right candidate will have a solid understanding of statistics, an ability to code in R and Matlab (or a willingness to learn quickly), a passion for transportation, traffic safety and public health. The student should be comfortable working on an interdisciplinary team and presenting results to different audiences.

FINE ARTS

Michelle Lopez

Project 1: Joplin Project: Digital Rendering/Video Animation/Computer Graphics ***Rising Junior only***

The Joplin Project is an interactive, multi-channel video installation, based on the namesake tornado of 2011. The Missouri devastation was the deadliest, multiple-vortex tornado in recent history that obliterated 9,000 structures of culture and society in a total of 38 minutes. It's width span was all-encompassing, rotating in a one-mile radius.

The Joplin Project simulates this phenomenon with electrical and sound engineers, computer programmers, digital renderers, and architects to render the epic tornado experience as a 4-D immersive form of sculpture, but also as a replication of our vast collective data of internet information spinning above us in the air.

The installation would be projected onto the walls of Philip Johnson's Glass House (New Canaan, CT) to create an interior and exterior view, the interior one being of the most important to the viewer experience as it situates the viewer in the eye of the storm.

In the destructive interior space of a rotating column of air, the material image, that will encompass all existing wall, ceiling and floor space, will disintegrate and whip in 200 mile-per-hour, 360-degree motion through all the wall surfaces, in symphonic, whirlwind-like effect, and

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collapse the space into silence as the viewer stands in the center. Much of my work has been about the removal of terror in reverse.

Pre-requisite: This project seeks collaborative students with knowledge/some fluency in the area of CGI software (Maya, Houdini, After Effects, Nuke) to help build the animated imagery of the tornado, smoke clouds, and flying particles in order to project it in 360-degree motion. We will also take our own video footage so knowledge of video capture, camera work, and filming a plus.

Project 2: Joplin Project: Robotics/Electrical Engineering ***Rising Junior only***

This collaboration focuses on the element of interactivity within the Joplin Project (described above) through robotics and motion-activated software employed in the space. As the viewers enter the space and moves towards the image on the wall, the image will come towards them and swell to its greatest strength. When the viewer moves away from the space, the image will recede and disappear. Likewise, on the ground, when the tornado moves under the viewer's feet, the objects will move around the body.

The research also explores diverse inventions of image projection: i.e. implementing a spinning zoetrope-like or mirrored structures to fracture the digitally manipulated image through the architecture. Another point of contact will be the interaction with the viewer and the image-making device.

Students will assist in building an apparatus that can potentially both interact with the viewers' movements and as a result of these interactions, project a constellation of spitted images onto a space. Each student is encouraged to work independently to come up with different solutions to structuring the sculpture: imagining a sculptural contraption to contain the image machine, or working specifically with motion sensors and the electrical engineering of the viewer movement and experience.

Pre-requisite: A background in Robotics, architecture, construction, electrical engineering; ability to problem-solve independently. The final project will be installed in art "institutions" and public spaces, so the students who would like to continue will be involved in all aspects of development, production, and exhibition.

Project 3: Joplin Project: sculptural mechanisms/architectural installation ***Rising Junior only***

This collaboration is an extension of the Joplin project (described above) and requires programmers who can take information data and produce an algorithm to affect the rate of the movement of the image.

IBM and WEATHER DATA: In order to "infect the image" I have been in conversation with IBM to access their international weather data of tornadoes and other natural disasters. In this

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project, the student will assist in developing software that will shape that information of IBM's 2 billion weather stations into a visual structure of natural phenomenon far more accurate and ominous that we could design ourselves. This meteorological mapping (detailed in terms of wind velocity, speed, rate of tornado, duration of weather) could be then used an algorithm to intersect with my rendered/physically produced moving image. The mapping could determine the speed, rate of shredding, as the image spins and rotates through the space. The data could also help determine the movement of the objects through patterning that I am hoping to broaden in my research.

The reason for this tornado data imaging has more to do with understanding public access to "information" data as a new kind of terrorism. I would like to deconstruct the metaphor into an exploding constellation of information violent and beautiful simultaneously. The project is meant to destabilize our space of information technology and social mediated identity. The final project will be installed in specific art "institutions" and public spaces, so the students who would like to continue will be involved in all aspects of development, production, and exhibition.

Pre-requisite: Students with the knowledge of Software Encoding and Computer Engineering required; ability to problem-solve independently.

Kenneth Lum

Project 1: Monument Lab exhibition of public art

A large-scale and city-wide contemporary art exhibition will open in September of 2017. Temporary works of art by major international and local artists will stage their proposals about an appropriate monument for the city of Philadelphia at this time in about 10 sites throughout the city, including the courtyard of City Hall and the four major squares (Rittenhouse, Washington, Logan and Franklin). There will be a public "lab" component set up for each of these sites where public programming in the form of entertainment and discussions will take place. The need is for a student to assist as in any way possible. Students who have some knowhow in carpentering or building or graphic arts would be encouraged to apply. Required is also students as general assistants, perhaps chaperoning artists, etc.

Orkan Telhan

Project 1: Bio Maker Lab – Artists/Designers

Bio Maker Lab is a new design platform that allows artists and designers to work with living organisms to create new materials, images, food, and various bioproducts. We need hard

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working creative minds that are willing to learn about synthetic biology and design to test new ideas and create tutorials for making them accessible to other artists and designers.

The premise of the project is to make biological accessible to non-biologists, so no prior background in biology is needed. Applicants are expected to know Adobe Illustrator and Photoshop and need to show a visual portfolio—drawings, photographs, prints, or animations—that communicates their aesthetic sensibilities. Knowledge of screen-printing is a plus.

Project 2: Bio Maker Lab – Interface Designers

Bio Maker Lab is a new design platform that allows artists and designers to work with living organisms to create new materials, images, food, and various bioproducts. We need creative makers that are willing to learn about synthetic biology and biological design to help us to develop the new versions of the Bio Maker Lab interface.

The premise of the project is to make biological accessible to non-biologists, so no background in biology is needed. Applicants are expected to know web design (HTML/CSS) and Adobe Photoshop. Knowledge of Javascript and some familiarity with back-end programming is a plus.

Project 3: Bio Maker Lab – Making/Engineering

Bio Maker Lab is a new design platform that allows artists and designers to work with living organisms to create new materials, images, food, and various bioproducts. We need creative makers that are willing to learn about synthetic biology and biological design to help us design the different components of the platform.

The premise of the project is to make biological accessible to non-biologists, so no background in biology is needed. Applicants are expected to have basic 3D modeling and fabrication skills (e.g., 3D printing, laser-cutting, and so on). Knowledge of mechanical systems is a plus.

LANDSCAPE ARCHITECTURE AND REGIONAL PLANNING

Raffaella Fabiani Giannetto

Project 1: Georgic Grounds and Gardens: From Palladio's Villas to American Plantations

A villa life based on the tradition of self-improvement handed down from the classical authors of Republican Rome and centered on agriculture as the most righteous source of profit, characterized both the aristocracy of 16th-century Venice and later that of the first large landowners of colonial America, from William Byrd II to Thomas Jefferson. Both Renaissance Venetians and early Americans chose similar architectural and garden forms to give shape to

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their villa ideology and England, the motherland of the early colonists, constituted a cultural bridge for the transmission of ideas about design and agriculture across the Atlantic.

My book manuscript, Georgic Grounds and Gardens: From Palladio's Villas to American Plantations, explores this transatlantic and cross-cultural phenomenon.

In the summer of 2017 I shall be conducting research on the practice of early American aristocratic families to send their children to England to study, just as several wealthy English families, in turn, sent their offspring on a European grand tour in the 17th and early 18th centuries to complete their education.

A student's research for this particular aspect of my book manuscript will contribute to the history of the reception of the villa model across cultures, shedding new light into the provenance of ubiquitous garden forms in the plantations of colonial America that are very much taken for granted in existing scholarly accounts. The student will participate in the collection, reading and sorting of selected primary sources, such as travel accounts, diaries, and epistolary exchanges that document American travelers' reception of the English countryside, its agricultural practices, design philosophies and traditions. A student's research will try to answer a few crucial questions, for example, what were the typical itineraries of American travelers in England? Which regions and country houses were the most visited and why? Was each new account original or was there a tendency to borrow from earlier writings? In order to answer these questions, a student may be asked to visit various archives and libraries in Philadelphia and its greater region.

Students with a strong interest in historical analysis, cross-cultural studies, architectural and/or garden design are encouraged to apply. No previous research experience is necessary.

Christopher Marcinkoski

Project 1: Africa 2050: An Atlas of Speculative Urbanization—New Town Typology Case Studies

This research task is part of a larger project—Africa 2050: An Atlas of Speculative Urbanization—which considers the proliferation of proposals for green-field new towns across the African continent. Despite urgent demand for urbanistic upgrades throughout the continent, much of the recent urbanization activity being pursued in this context is rarely oriented toward those populations actually in need. Rather, exogenous models of "proven" urban growth strategies are being imported into wholly incongruous contexts with little regard for the realities of their destination. As a way of sorting and evaluating the more than 150 speculative new town projects that have been proposed in the last decade and identified by this research, seven distinct typologies of speculative urban form have been defined.

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The selected student will work with the research team to develop a bibliography and literature review for the chosen case study related to each of the seven typologies. Source material is anticipated to include press releases, news stories, sales propaganda, consultant interviews, and developer consultations where available, as well as reviewing the limited extant scholarly work that addresses the cases. This work will contribute to a public exhibition and book publication.

The selected student will have the opportunity to study an emerging urban phenomenon with far-reaching social and environmental impact. Students with an interest in Real Estate, Urban Studies, Architecture, Urban Design, Planning and/or African Development are encouraged to apply. Fluency in Arabic, French, Dutch, Portuguese and/or Mandarin is desired, but not required.

Project 2: Africa 2050: An Atlas of Speculative Urbanization—Intergovernmental Urbanization Programs

This research task is part of a larger project—Africa 2050: An Atlas of Speculative Urbanization—which considers the proliferation of proposals for green-field new towns across the African continent. Despite urgent demand for urbanistic upgrades throughout the continent, much of the recent urbanization activity being pursued in this context is rarely oriented toward those populations actually in need. Rather, exogenous models of "proven" urban growth strategies are being imported into wholly incongruous contexts with little regard for the realities of their destination.

The entities behind these projects range from state development, housing and infrastructure agencies, to private international real estate corporations, to sovereign investment funds, to parastatal planning consultancies. However, regardless of the primary actors involved, many of these projects are subsidized to varying degrees by intergovernmental programs that are focused on providing direct development aid in the Global South. These intergovernmental programs are characterized by a range of priorities, but for the purposes of this research, we are interested in those programs that support the infrastructure and settlement projects that drive the speculative urbanization activities at the center of this research.

The selected student will work with the research team to collect and document the structure and orientation of these various intergovernmental urbanization programs, as well as index and cross-reference those programs that have supported or are supporting projects identified in the Africa 2050 Atlas.

Students with an interest in Real Estate, Urban Studies, Architecture, Urban Design, Planning and/or African Development are encouraged to apply.

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Richard Weller

Project 1: Atlas for the End of the World

One PURM researcher is required to work under the direction of Professor Richard Weller on a project concerning the ways in which cities in the world's 35 biological hotspots are growing. Specifically, we will be looking in greater detail at the periphery of 422 cities which our research has already identified as sprawling into remnant habitat, on collision courses with threatened species. The task is to catalogue google earth imagery of the various forms of peri-urban growth taking place and match this imagery to summaries of the policy settings in each city (if any) in regard to biodiversity. The researcher will be trained in the requisite graphic skills and the results will be published in the form of a web based platform titled 'Atlas for the End of the World'.

Project 2: LA+ NEW *Rising Sophomore only*

Biannually, the landscape architecture department at PennDesign produces a high quality interdisciplinary design journal titled LA+ (Landscape Architecture Plus). Each issue is themed; for example, recent issues have been published on the themes Wild, Pleasure, and Tyranny. The process of producing an issue of the journal begins with a comprehensive, interdisciplinary literature review to establish key lines of inquiry and identify potential authors who are then invited to write for the journal. One PURM researcher will be required to conduct a literature review for a forthcoming issue. The theme to be explored is "New".

The theme of "New" pertains to new ideas, styles, and techniques of contemporary design.

In line with the journal's interdisciplinary mandate the research will be wide-ranging whilst always asking how innovations in different fields might impact our cities and landscapes. You will work closely with the Journal's Editor in Chief Dr Tatum Hands and Creative Director Professor Richard Weller and will learn how to conduct a thorough literature review. Additionally, you will be invited to participate at key moments in the journal's production process in the following Fall semester so as to learn about the entire process of delivering a journal to press. Researchers will be credited in the issue. To get a feel for the journal visit http://laplusjournal.com

Project 3: LA+ PLANTS *Rising Sophomore* only

Biannually, the landscape architecture department at PennDesign produces a high quality interdisciplinary design journal titled LA+ (Landscape Architecture Plus). Each issue is themed; for example, recent issues have been published on the themes Wild, Pleasure, and Tyranny. The process of producing an issue of the journal begins with a comprehensive, interdisciplinary literature review to establish key lines of inquiry and identify potential authors who are then

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invited to write for the journal. One PURM researcher will be required to conduct a literature review for a forthcoming issue. The theme to be explored is “Plants”.

The theme of “Plants” pertains to interesting ways in which plants are used in industry, agriculture, architecture and popular culture.

In line with the journal’s interdisciplinary mandate the research will be wide-ranging whilst always asking how innovations in different fields might impact our cities and landscapes. You will work closely with the Journal’s Editor in Chief Dr Tatum Hands and Creative Director Professor Richard Weller and will learn how to conduct a thorough literature review. Additionally, you will be invited to participate at key moments in the journal’s production process in the following Fall semester so as to learn about the entire process of delivering a journal to press. Researchers will be credited in the issue. To get a feel for the journal visit http://laplusjournal.com

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Education

READING/WRITING/LITERACY

Ebony Elizabeth Thomas

Project 1: Restorying Our Histories and Ourselves: An Investigation of Reader Responses to Historical Fiction

In the age of the Common Core State Standards (CCSS), seventy (70) percent of United States students' reading across the curriculum must consist of informational texts by high school. Debates in the field about distinctions that literacy and ELA educators must make among informational texts, nonfiction, and literature are substantial and ongoing. However, in many of these conversations, historical literature of all kinds for young people have been given short shrift. Therefore, a more comprehensive consideration of how teachers guide children's and adolescents' historical understanding as they respond to literature is warranted, especially in light of changing demographics, and shifting perceptions about racial identities and social subjectivities. Within broader considerations about the teaching of literature, this project will examine African American literary pedagogy as a critical site for teaching key events in our nation's history. This interactional ethnographic study, based on current and anticipated research at three schools in the Philadelphia area -- one (1) elementary, one (1) middle school, and one (1) high school -- and with a self-selected group of teachers will provide new insight into how children and adolescents read, interpret, and construe time, value, and meaning from informational texts about the past across the grade span.

This research study offers unique opportunities for enthusiastic and engaged Penn undergraduate students to work with young adolescents in an urban setting. This proposal offers students an opportunity to engage in qualitative research design, implementation, analysis, and dissemination of research results alongside a member of the standing faculty and graduate student researchers. Students, after training, will also assume significant responsibility for staffing an underresourced high school library media center during the summer term.

The job description for the undergraduate student researcher(s) will include one or more of the following duties:

Assist the principal investigator, project manager, and co-facilitators, in the design of, implementation of, data analysis, and dissemination of results from a qualitative research study at a Philadelphia area school.

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Engage in collection planning and materials management for a library media center.

Facilitate a high school student book club.

Collaboratively plan programming for students, staff, and the community.

Advocate for the importance of literacy learning (and the interdisciplinary nature of history and literature pedagogy at the K-12 level) as a result of this experience.

Project 2: Humanizing Stories: Using Social Media for Literary Diversity and Justice

Humanizing Stories is an ongoing digital research and advocacy project prioritizing and promoting children's and young adult literature, media, and culture that is in "pursuit of a fuller humanity" (Freire, 1970, p. 47) through representations of diverse and richly complicated people and communities that offer alternative points from which to view and imagine the world (Myers, 2014, n.p.). This action research project seeks to discover justice-oriented, anti-oppressive, empowering, and emancipatory stories for all young people through social media engagement with stakeholders in the children's publishing and media world, parents and families, and youth and young adults engaged in talking about children's literature and YA fiction.

Selected students will, alongside graduate student researchers and the faculty principal investigator:

-- Research, critique, and recommend texts that speak from marginalized and often silenced perspectives and voices on those individuals' and communities' terms via an established social media account, @HealingFictions.

-- Along with a member of the standing faculty and graduate student researchers, create web resources to guide educators, families, and communities toward children's literature, media, and material culture that celebrates the stories and lifeworlds of every child.

--Administer a digital survey evaluating users' responses to the website and existing social media accounts.

TEACHING, LEARNING, AND LEADERSHIP

Yasmin Kafai

Project 1: Evaluating Professional Development for STEM Educators

The mission of the Philadelphia Education Fund (ED Fund) is to cultivate exceptional outcomes for students. Its STEM (science, technology, engineering, and math) initiatives include

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professional development (PD); resources such as a monthly newsletter and STEM field trip and outreach directories; and leadership roles in regional, statewide, and national STEM activities.

The Ed Fund performs extensive evaluations of its STEM PD offerings. These evaluations involve short-term and long-term assessments and quantitative and qualitative data. Based on Guskey's (1998) levels of PD evaluation and the OSTRC's Survey Toolkit (2009), the Ed Fund strives to answer: What types of professional development for STEM educators has the most significant, positive, and sustained impact on staff, programs, and students?

The Ed Fund seeks summer interns to clean, enter, analyze, and report on data gathered from the previous year's PD activities. These findings will help shape the coming year's PD offerings and ensure positive experiences and outcomes.

Interns should be familiar with qualitative and quantitate research; have excellent written and verbal communication skills; be fluent in basic computer technology; and be comfortable working alone and a part of a team. Interns will learn about STEM programming and curriculum, professional development, and PD evaluation. Interns will also interact with multiple stakeholders from local, regional, and national STEM education organizations.

Nancy Peter, Ed.D, is an adjunct professor at the Graduate School of Education, and Director of STEM Initiatives at the Philadelphia Education Fund. Dr. Peter will supervise the students in this placement.

Project 2: Scientists as Educators

The mission of the Philadelphia Education Fund (ED Fund) is to cultivate exceptional outcomes for students. Its STEM (science, technology, engineering, and math) initiatives include professional development (PD); resources such as a monthly newsletter and STEM Field Trip and Outreach Directories; and leadership roles in regional, statewide, and national STEM activities.

The Ed Fund administers "Explore STEM Philly," through which STEM professionals serve as Career Coaches in local classrooms. These Coaches cover content, inquiry activities, and career options; many also host field trips at their work sites. The ED Fund continually evaluates this program and refines its training materials. Our research question is: How can we best help STEM professionals ignite STEM curiosity and career aspirations among students?

The Ed Fund seeks summer interns to clean, enter, analyze, and report on data gathered from the previous year's programming. Interns will also research others training materials and help improve our current curricula. These tasks will help shape the coming year's programming and ensure positive outcomes.

Interns should be familiar with qualitative and quantitate research; have excellent written and verbal communication skills; be fluent in basic computer technology; and be comfortable

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working alone and a part of a team. Interns will learn about STEM programming, curriculum, and assessment. Interns will also interact with stakeholders from local, regional, and national STEM organizations.

Nancy Peter, Ed.D., is an adjunct professor at the Graduate School of Education, and Director of STEM Initiatives at the Philadelphia Education Fund. Dr. Peter will supervise the students.

Rand Quinn

Project 1: Gentrification and parent problem solving in schools

What are the processes by which gentrification structures parent problem solving in schools? To answer this research question, this fall we will conduct a cross-case comparison of parent problem solving in two elementary school communities in Philadelphia that share a catchment border but that are at different stages of gentrification. One school is gentrifying and the other school has yet to gentrify. We might expect that the dense, insular community found in communities that aren't gentrifying provides a lubricant for effective parent problem solving due to the high levels of trust and reciprocity community members likely share. The process is less clear for communities that are gentrifying. Under certain conditions, gentrification may undermine parent problem solving by creating splintered or duplicative collective action efforts, or efforts that only benefit a subset of the school. However, under a different set of conditions, we might expect the more internally diffuse but externally connected community found in gentrifying schools to provide a different kind of lubricant for parent problem solving. In this case, gentrification may actually increase the reach of existing parent problem solving efforts that lead to direct or spillover improvements for all students. Our study is designed to identify these processes.

Over the summer, our PURM student will work with us on the following research activities: (1) conducting a literature search on gentrification and schools; (2) developing our interview and observation protocols; (3) field testing our protocols; (4) designing parent workshops on coalition building and conflict resolution.

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Engineering and Applied Sciences

BIOENGINEERING

Danielle Bassett

Project 1: (Machine) Learning of Optimal Transmission of Bioengineering Discoveries

In this project, students will use and develop code to extract patterns in peer-reviewed articles in prestigious bioengineering and related journals. The goal will be to understand the patterns of information transmission that are most predictive of the article's impact on the existing body of knowledge and subsequent directions of scientific inquiry. Other bodies of written work will be compared to these articles, including stories, and children's soliloquies. The project requires extensive familiarity with computer programming, creative problem solving, and independence.

Project 2: The language of mathematics

Students interested in epistometrics, forms of knowledge (in the philosophical sense), and knowledge spaces (in the mathematical sense), could be a good fit to a new project focused on quantitatively characterizing the language of mathematics. The project will include curation of relationships between mathematical concepts, the study of the architecture of these relationships, and the study of how humans learn these relationships. Creativity, independence, love of mathematics, and coding experience required.

Project 3: A network science of quantum transport

Enamored after taking quantum? We have begun a new project studying the manner in which atoms transition from one energy state to another using an emerging set of conceptual tools and theories from network science and complex systems theory. Participating in the project will give students experience with an emerging sub discipline of physics (network science), and how it can offer fundamental new insights into a classical sub disciplinary of physics (quantum mechanics). Creativity, independence, love of physics, and coding experience required.

Christopher Fang-Yen

Project 1: Exploring a worm's sense of touch using a novel microfluidic device

The sense of touch is important for a wide range of animal behaviors. There are many open questions about how the touch sense functions and how it is regulated. The 1-mm long

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roundworm C. elegans has long been used as a model of touch sensation in animals due to its short life cycle and simple genetics. We are developing a microfluidic device assay that can measure many individual animals' touch response behavior at once. In this device, worms crawl through a set of 64 parallel sinusoidal channels while a separate set of channels on another layer apply touch stimuli to the worms when pressurized. The device allows us to measure the relative touch sensitivities of different mutant strains under different osmotic and pharmacological conditions as well as the receptive field of subsets of the touch receptor neurons. Using image analysis, we will also be able to study sensory and behavioral adaptation to multiple stimuli as well as reaction time. If successful, this work is likely to lead to meaningful, publishable discoveries about how the sense of touch and touch response behavior are regulated. The student will design and carry out experiments, maintain worm strains, and perform image processing and data analysis. The candidate must have excellent fine motor skills, since the work involves assembling devices precisely and working with microscopic organisms under a stereo microscope. Some laboratory and computer programming experience, particularly in MATLAB, is helpful but not required.

Project 2: Optogenetic analysis of a worm's locomotory circuit

Our laboratory investigates how neural circuits create behavior, using the roundworm C. elegans as a model. Although C. elegans is the only organism for which we have a "wiring diagram" – a map of all neurons and their synaptic connections, it is still unclear which synaptic and electrical connections are functionally significant in the worm's brain. In this project we will use investigate the functional connections in the motor circuit, responsible for controlling the animal's movements and navigation. We will apply optogenetics, in which light-controlled proteins are used to optically control activity in specific neurons, to stimulate a particular motor neuron in the worm, then measure the resulting behavior and activity in connected neurons and/or muscles using a calcium-sensitive fluorescent protein. We will also use a novel laser thermal ablation system to kill specific cells or sever their nerve fibers. This work will pave the way for the functional interpretation of structural connectomes in more complex species. The student will be trained to operate a modified microscope that supplies blue or green laser illumination to a targeted neuron while simultaneously recording fluorescence images of nearby neurons or muscles. The candidate will prepare and conduct experiments, perform data analysis, and interpret results. Some computer programming experience, particularly in MATLAB, is helpful but not required.

Project 3: Exploring the genetics of aging using a microfabricated device

As the average age in the developed world continues to increase, it is becoming more and more critical to understand the basic mechanisms of aging and develop strategies for mitigating its effects. The microscopic roundworm C. elegans is an ideal model for studying aging since its normal lifespan is only about 2 weeks, and it is easily manipulated genetically. Research in C. elegans have contributed greatly to this effort by identifying many widely conserved pathways

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and processes that regulate aging. Traditional studies of C. elegans aging are based on low-throughput manual inspection of individual animals on plates, and focus largely on lifespan. A more complete understanding of aging will require measures of healthspan (the time during which an animal is in good health) in addition to lifespan. We have developed a microfabricated multi-well device called the WorMotel which is capable of automatically monitoring behavior and lifespan in tens of thousands of C. elegans simultaneously. We are applying the WorMotel to screen for genes and pharmaceutical compounds that affect healthspan and lifespan. The candidate will be trained to fabricate, fill, and load WorMotels with worms. He or she will conduct experiments to test the effect on healthspan and lifespan of various genes and compounds. Some laboratory and computer programming experience, particularly in MATLAB, is helpful but not required.

COMPUTER AND INFORMATION SCIENCE

Shivani Agarwal

Project 1: Machine Learning Methods for Ranking and Choice Modeling ***Rising Junior only***

In today's big data era, data in the form of rankings and choices arises in numerous domains, including in particular consumer surveys and marketing applications. There is currently much interest in machine learning methods that can be used to automatically analyze such rankings/choice data and extract meaningful insights from it. This project is designed to give an undergraduate student an opportunity to be involved in new research directions in the area of ranking and choice modeling in machine learning. The project will involve some or all of the following: (a) collecting choice survey data; (b) developing/optimizing computer code to implement machine learning methods for analyzing rankings/choice data; and (c) documenting work done during the project. The student working on this project will also have an opportunity to interact with graduate students and/or postdoctoral fellows in our research group. The student is expected to have strong mathematical and computer programming skills, to be highly motivated, to be willing to learn new concepts as needed for the project, and to be able to work well both independently and in a team.

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Norman Badler

Project 1: Virtually interacting with the past

This project involves virtually recreating, repopulating, and interactively experiencing prehistoric sites. The research goals are to understand and reanimate the likely or typical (day-to-day) and extraordinary (festivals, religious celebration) events that a particular site supported. Various software tools will be used such as Maya 3D modeling system and the Unreal game engine. Additional software development to support technical contributions such as user interfaces to environment-driven behaviors, interpersonal interactions, and culture-specific characters are just some of the projects that could be undertaken. Not only will these projects engage students in contemporary research, but they will also help transition these research products into classroom experiences and even public outreach. Students are expected to have at least one year of computer programming coursework (C++, C, or Java), and experience with 3D modeling and/or game engines is a plus. Interest in anthropology or archaeology would be helpful. Students will work in mentored teams under the supervision of Prof. Badler of Computer and Information Science and his colleague Prof. Clark Erickson from Anthropology.

Nadia Heninger

Project 1: Anomaly testing for Internet security ***Rising Junior only***

Security researchers discover critical vulnerabilities in computer software with distressing frequency. This project takes a data-oriented approach to measure the impact of known vulnerabilities and discover new vulnerabilities in cryptographic protocols. Our lab has large quantities of internet measurement data, and infrastructure to collect more. We are looking for student researchers to analyze our datasets. The research activities will include background reading to get up to speed on networking and internet protocols as well as the types of security vulnerabilities we are searching for, training on our database and distributed cluster setup, writing scripts to process, analyze, and perform computational tests on data, and examining implementations to validate results. Students should have experience programming (we mostly use Python, C, and Go; CIS 120, 121, and 240 should provide a good background to learn any new languages or concepts) and a strong interest in computer security and cryptography.

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Ani Nenkova

Project 1: Automated methods for qualifying the ambiguity of regulatory law ***Rising Junior only***

One of the most pressing questions in United States government today is whether law effectively constrains bureaucrats. Just how much discretion do statutes give bureaucrats? How can we measure this discretion in regulatory law? How much ambiguity is left after Congress passes itslaws?

This project proposes to bring machine learning methods to bear on these critical questions, providing a unique opportunity for computer science undergraduates to do applied work in the law. As part of the project, students will develop a supervised classification machine learning algorithm that can predictand quantify the ambiguity of legal texts like statutes and regulations. Students will use a pre-coded set of statutes to train and validate the classifier algorithm. The resulting work will inform research in administrative and regulatory law, answering important questions about the extent of bureaucratic discretion, but it will also have practical applications such as providing a tool to legislative drafters to improve the clarity of their work. It will also bring computational linguistics to a field that deals primarily with texts, and is therefore ripe for further developments and avenues of inquiry.

Students would be supervised by faculty in the Computer and Information Science Department and in the University of Pennsylvania Law School.

Val Tannen

Project 1: Debugging wrong answers given by database queries

Debugging database queries is difficult because the relationship between the answers and the enormous amount of information in today's databases is hard to track and therefore hard to understand. For a number of years Tannen has developed a mathematical and computational framework for data provenance that tracks this relationship. Since 2007, this work has successfully resulted in 25+ publications in notable venues.

A recent breakthrough obtained in collaboration with mathematical logician Erich Grädel (RWTH-Aachen) has opened a new research direction: tracking the reasons for the absence of critical information in the answer given by a database query. This project is concerned with two aspects emerging from this: (1) further developing the Grädel-Tannen mathematical framework used in the work, and (2) designing, prototyping, and applications of these ideas to debugging Excel spreadsheet and Google Sheets documents.

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The Penn undergraduate student that would take part in this project must be both motivated in advanced Computer Science (algorithmic applications to data management), and have a demonstrably deep interest in Mathematics, (logic, combinatorics, and algebra).

The student will interact regularly with Tannen and one or two Penn PhD students, as well as with Prof. Grädel (by Skype). The student will have the opportunity to significantly expand his or her knowledge in some areas of math, to understand and practice the unique nature of Computer Science research, to design and prototype software plug-ins for widely used software, and possibly to co-author scientific publications.

Lyle Ungar

Project 1: Analysis of Twitter discussions of risky behaviors ***Rising Junior only***

We propose to analyse the public twitter discussions relating to sex, abstinence, STDs and HIV. To do this, we will take a large random sample of tweets (roughly 10 billion) from the US. We will then select tweets that contain any of a specified set of keywords relevant to the topics of interest, and gather further tweets from the tweeters. We will then apply a number of language-based statistical models to them to estimate the age, sex, socioeconomic status and personality of the tweeters. The goal is to get a picture of what the public twitter dialogue can tell us about the attitudes of different subgroups towards these topics. The student(s) on this project should know programming at the level of CIS121, and be conversant with python. Into statistics or machine learning a plus. This work will be done under the mentorship of Prof Lyle Ungar (CIS) and the "word well being project" (wwbp.org) at the positive psychology center at Penn.

ELECTRICAL AND SYSTEMS ENGINEERING

Cherie Kagan

Project 1: Probing Carrier Physics in Quantum Dot-Based Solar Cells

Quantum dot (QD) arrays have garnered large amounts of interest as a platform for exploring fundamental physical processes and as candidate materials for next-generation electronic devices. Though hampered by the inherent energetic and structural disorder due to their non-crystalline structure, QD solar cell devices have recently pushed past 10% efficiency, and can be fabricated using low-cost solution processing. Continuing to push efficiencies so that next-generation devices can take advantage of the processing advantages QD technologies present requires a deeper understanding of energetic disorder, which manifests itself as charge traps that

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affect the lifetime and mobility of photo-excited carriers in a QD material. We aim to understand the fundamental physical and electronic nature of the inherent carrier traps in quantum dots by observing how the conductivity and capacitance of a QD device change in response to the application of an AC perturbation at various temperatures.

A PURM student will work directly under the supervision of a Ph.D. candidate in the Kagan lab and perform electronic and spectroscopic characterization of QD films. The student will learn how to fabricate a QD device, perform cryogenic conductivity and capacitive measurements, and work up the data to eventually be included in a publication. Familiarity with MATLAB or Python is helpful, but a deep interest in applied physics and a willingness to perform hands-on work in a lab environment is required.

Students in physics, electrical engineering, or materials engineering are encouraged to apply.

MATERIALS SCIENCE AND ENGINEERING

Ritesh Agarwal

Project 1: Optimizing light matter interactions in nanoscale cavities for efficient photocatalysis from solar energy to fuels

Metal nanostructures possess interesting optical properties because of presence of collective oscillations of electrons called surface plasmon resonances (SPRs), which when integrated with semiconductors influence the properties of the system significantly. The hot electrons generated via plasmon excitation can either be used to aid electron transfer in chemical reactions or to generate local heat for various applications such as photothermal therapy for cancer treatment, nano-surgery, photothermal drug delivery, photothermal imaging and nanochemistry. Gold is the most commonly used plasmonic metal because of its inert nature and its plasmonic resonances lying in the visible to infrared range, which can be tuned by altering the shape and size of Au nanostructures. Most plasmonic devices fabricated till date, rely on the naturally occurring resonances of the synthesized nanostructures to harvest electromagnetic radiation for heating and/or catalytic applications. However, if the SPR excitations can be significantly enhanced by an engineered external cavity, it can lead to intense heating or increased catalytic activity.

The proposed activity would involve fabricating a semiconductor-metal nanowire cavity to enhance the plasmonic properties of Au nanoparticles leading to intense heat generation at cavity mode resonance. The combined effect of high refractive index core (e.g. Si) along with an effective metallic cavity should be able to confines light to an intense mode which leads to strong absorption. Furthermore, the evanescent field from this mode extends into the Au particles of the

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thin-film can cause much stronger excitation of localized surface plasmons (LSPs) thereby heating the cavity to very high temperatures and also produce hot electrons for enhancing photocatalysis. Our preliminary data is very promising.

The project would involve fabricating nanoscale cavities that optimize cavity size, metal film thickness and then perform Raman analysis to study the effect of laser heating on cavity temperature. The results will be analyzed with the help of numerical calculations. The devices will be optimized to produce maximum heating with minimum excitation energy. The most promising systems will be utilized to study photocatalysis. These studies will be useful for making very efficient photocatalyst systems to convert solar energy to usable fuels.

The undergraduates will be mentored by a postdoctoral fellow (Dr. Young-Chul Leem) along with Prof. Agarwal.

Eric Detsi

Project 1: Real-time in-situ monitoring of volume changes in nanoporous metals during electrochemical dealloying

Nanoporous metals undergo significant volume changes (up to ~30 %) during their fabrication by dealloying. So far, these volume changes are observed by comparing the size of the material before and after dealloying. Real-time monitoring those volume changes during the dealloying process is not yet investigated. In this project, the abovementioned volume changes will be measured in real time and in-situ during electrochemical dealloying. The outcome of this study will shed more light on the dealloying mechanism.

Project 2: High-performance nanoporous alloy-type anodes materials for next generation energy storage

Next generation metal-ion batteries will require anode materials with much higher energy densities than graphitic carbon used since a few decades as anode in most commercial Li-ion batteries. In this project, the student will fabricate and test nanoporous materials as alloy-type Li-ion, Na-ion and Mg-ion battery anodes. The primary goal is to invesitgate structure-property relationships between the microstructure of the nanoporous materials and their performance as electrochemical energy storage materials.

Project 3: Direct conversion of liquid water to vapour on plasmonic nanoporous metal films

Plasmonic metal nanoparticles can convert liquid water to vapour without boiling it. This happens during localized surface plasmon resonance in the nanoparticles. The conversion efficiency of the process is relatively low and we hypothesize that using plasmonic nanoporous

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metal films instead of metal nanoparticles to convert liquid water to vapour will enhance the conversion. The student will experimentally verify our hypothesis by fabricating plasmonic nanoporous metals and investigating their activities toward the conversion of liquid water to steam using sunlight.

Christopher B. Murray

Project 1: Surface activation of nanocrystal catalysts

Mentors: Ms. Jennifer D. Lee and Prof. Chris Murray

Using colloidal nanocrystals as active catalysts has received increasing attention in biomass conversion reactions due to its excelled activity, stability and selectivity. One of the main challenges in designing high-performance catalysts is to achieve high-quality catalyst surfaces. This is particularly important when using colloidal synthesis methods that employ organic ligands as stabilizing agents. With the aim of obtaining clean catalytic surfaces, this PURM project would focus on understanding the efficiency of different surface treatments for removing organic ligands and activating catalytic nanocrystals with high reproducibility. This would involve some exposure to the colloidal synthesis of transition metal nanocrystals, but would focus on processing, characterization and functional testing. Chemical stripping, UV-ozone cleaning and plasma treatment as well as the combination of different treatments will be investigated. The student will have experience in techniques including XRD, TEM, FT-IR, ICP-OES, TGA-MS etc.

Project 2: Analytical studies of liquid-phase products in hydrodeoxygenation (HDO) reactions

Mentors: Ms. Jennifer D. Lee and Prof Chris Murray

HDO reactions have been identified as a critical step in the production of liquid fuels from biomass. The qualitative and quantitative analysis of reaction products has been the keystone of a thorough understanding of HDO reactions. Lots of efforts have been done using high-performance catalyst to further improve the reaction efficiency, in which the more detailed understanding of reaction mechanisms and pathways undoubtedly provides the clues of exploring better catalysts. A critical step in developing that understanding is to quantify the liquid product distribution resulted from different catalysts and diverse reaction conditions. This work will solidify theoretical knowledge of this student and also expose him/her to catalytic functional testing and examination of different analytical methods for product analysis. This PURM project would use a gas chromatography (GC) equipped with a thermal conductivity detector (TCD) together with FT-IR, NMR, and mass spectroscopy to identify and map product distributions.

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Project 3: Controlled Silica Coating of CTAB-Capped Gold Nanorods with Secondary Functionalization Using Polymeric Ligands

Mentors: Ms. Nadia Krook and Prof. Chris Murray

Colloidal gold nanorods (AuNRs) have been widely studied for their tunable optical properties. The ability to alter the longitudinal surface plasmon resonances by changing the AuNR aspect ratio has made these colloidal systems attractive as colourants, as optical data storage, and as a material serving the biomedical community for photothermal therapy and imaging. Overcoating AuNRs with a silica shell imparts thermally stability to prevent particle reshaping while heating and also allows for easy surface functionalization with polymeric ligands. The objective of this project is to control silica coating of CTAB-capped AuNRs for a thin shell to minimally disrupt the particle aspect ratio and then establish a secondary functionalization with polymeric ligands. The overarching goal is to establish a system of thermally stable anisotropic particles that are miscible in a polymer matrix to create nanocomposites with attractive optical properties. Through this project, the student would become proficient in synthesizing AuNRs, silica coating of the AuNRs through the standard Stöber method, and chemically modifying the surface chemistry to incorporate into polymer matrices. Apart from the aforementioned capabilities, students will learn characterization techniques such as ultraviolet-visible absorption spectroscopy (UV-Vis) and Fourier transform infrared spectroscopy (FTIR) while also being exposed to transmission electron microscopy (TEM).

MECHANICAL ENGINEERING AND APPLIED MECHANICS

Robert Carpick

Project 1: Improving the Efficiency and Durability of Automotive Engines with Nanoscience: Mechanisms of Growth and Wear Protection of Tribofilms from Anti-Wear Lubricant Additives using In-Situ Atomic Force Microscopy ***Rising Sophomore only***

Improving the efficiency of automotive engines is a crucial and important goal for reducing energy consumption as well as reducing global greenhouse gas (GHG) emissions. Transportation accounts for nearly a third of all energy consumption in the US and is the single-largest contributor to GHG emissions. Deploying lower viscosity engine oils is critical for achieving these goals, as they reduce viscous losses in the engine. However, lower viscosity lubricants dramatically increase the likelihood of wear and failure in the absence of effective anti-wear (AW) additives, and the current generation of additive technology is potentially insufficient for next-generation engine oils. A more fundamental scientific understanding of the interfacial

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mechanisms of AW additives is needed to improve reliability in low viscosity lubricants and thereby to reduce overall GHG emissions in the transportation sector.

The efficiency and reliability of large and complex mechanical systems is fundamentally dictated by the material and mechanical performance of the numerous contacting surfaces in relative motion comprising them. Intrinsically, friction and wear at these macroscale contacts results from the mechanics and chemistry of discrete atomic and nanoscale interfaces. In addition to inherent challenges associated with probing the nanoscale, a fundamental constraint in understanding interfacial phenomena is the inability to directly probe a buried sliding interface. The advent of the Atomic Force Microscope (AFM) has greatly advanced our ability to probe nanoscale phenomena while also tracking the topology of the buried interface. Employing the AFM as a 'nanotribometer', our lab has already gained valuable insights into how conventional lubricant additives operate (Gosvami and Carpick et al., Science, 2015, http://dx.doi.org/10.1126/science.1258788).

A key focus of our current research is developing a fundamental scientific understanding of AW additive mechanisms in novel base oil and co-additive chemistries. These co-additives include friction modifiers, detergents, anti-oxidants, dispersants, etc., which may interfere with the ability of AW additives to provide adequate wear protection. An improved understanding of these mechanisms will result in the development of ultra-low viscosity engine oils with sufficient wear protection, which will result in vastly reduced energy consumption and GHG emissions through reductions in friction.

The incoming undergraduate researcher will assist a laboratory research manager by conducting hands-on experiments on an AFM, and potentially other complementary lab instruments, in addition to conducting data analysis on a range of software, including MATLAB, etc. This research is heavily focused on publication and there will be opportunities for co-authorship on peer-reviewed journal articles and presenting at research symposia. Prior experience operating an AFM is not a prerequisite for this position.

Project 2: Instrumenting an Atomic Force "Macroscope" for Visualizing Nanoscale Contact Mechanics ***Rising Junior only***

Mechanical systems consist of, and rely on, contacting surfaces for effective transmission of force and motion. Efficiency and reliability of such systems therefore derives from the mechanical behavior of materials at these interfaces, which is inherently multi-scale. At the smallest length scale, the interface between two opposing surfaces in relative motion consists of numerous nanoscale bumps called asperities. Interactions of opposing asperities result in macroscopically observable behavior such as friction and wear. Nanoscale studies using atomic force microscopy (AFM) have greatly advanced scientific understanding of fundamental processes at the single-asperity length scales. The AFM also serves as an excellent demonstration

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of fundamental principles of the nanoscale. However, the components of an AFM are too small to visualize directly, so commercial instruments cannot easily be used for instructional purposes.

Our lab has developed a fully functional, scaled-up AFM to directly visualize the forces and surface topography at a sliding contact. This atomic force "macroscope", developed as a macroscale analog to the atomic force microscope, uses optical force transduction and a cantilever assembly similar to a commercial AFM. Through the optical lever assembly, cantilever deflections in response to interfacial sliding are tracked by a laser that is focused on a photo-sensitive diode. The photo diode is connected through data acquisition hardware to data acquisition software on a computer. The sample is driven by a positioning stage with a stepper motor, which is also controlled by the computer. The atomic force macroscope helps clearly visualize the mechanical behavior of an otherwise nanoscale contact.

The incoming undergraduate researcher will assist a doctoral student in the lab with further developing the capabilities of this custom-built instrument. Specifically, the incoming researcher will design a new, self-contained frame for the instrument, and will reconfigure the electronics and the data acquisition program to permit operation of the stage independent of the computer. The researcher should have a keen interest in machine design and instrumentation. Prior experience with drafting software (such as SolidWorks, etc.), a basic understanding and some hands-on experience with electrical circuits, as well as a basic understanding or prior experience with LabView is strongly desired, but not necessarily required.

In addition, if sufficient progress has been made, then depending on the student's proficiency, exposure to an actual atomic force microscope to perform experimental measurements in support of ongoing research is possible.

Jordan Raney

Project 1: 3D printing bot

3D printers have become a popular way to produce intricate 3D structures in a layer-by-layer manner. With common commercial printers, this is accomplished by using stepper motors to translate a nozzle over a platform while it extrudes material. In this project, we are exploring the feasibility of using inexpensive robotics components to build a mobile 3D printing platform. The goal would be to use this sort of device to, for example, move a materials extrusion system to a hard-to-reach location in need of a repair, and then directly apply material to this location. Interested students should be comfortable with hands-on work, design, and coding.

Project 2: Tough inks for 3D printing improved structural materials

By allowing the assembly of structures layer by layer, 3D printers have enabled new design spaces for engineers and designers to explore. However, there are still many materials

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challenges associated with 3D printers (generally low quality materials), which tend to limit their use to prototyping and modeling contexts. In order to achieve the benefits of 3D printing (i.e., precise control of internal structural features) in a manufacturing context, much better materials are needed. One of the strategies found in natural materials that is associated with high toughness is the combination of stiff but brittle materials with soft but ductile materials. The goal of this project is to characterize different materials combinations to find improved constituents for the design of new 3D printing inks that are able to produce tougher structures. Students interested in this project should be comfortable working with chemicals in an environment typical of chemistry labs.

Kevin Turner

Project 1: Robotic gripping via switchable adhesive surfaces

Insects and lizards, such as the gecko, achieve adhesion to a wide variety of surfaces via gripping pads that are covered with micro- and nano-structures. These small-scale structures result in adhesion that is strong and switchable, i.e. can be changed from strong to weak through direction of loading. We have recently developed synthetic micro-structured polymer adhesives that offer strong and switchable adhesion, similar to the gecko. The objective of this summer undergraduate research project is to design, fabricate, and test robotic grippers based on these microstructured adhesives. This project will involve computational modeling to design the gripper, microfabrication and 3D printing to fabricate the adhesive and gripper, and mechanical testing to evaluate performance.

Project 2: Design and fabrication of materials with tunable rigidity

Materials with tunable rigidity (i.e., stiffness) have applications in soft robotics as well as other fields. There are few materials available currently that allow for the dynamic tuning of stiffness. However, recent advances in microfabrication and 3D printing have opened up new opportunities to realize materials with controlled structure that enable the tuning of rigidity. In this summer project, the student will investigate strategies for realizing materials with tunable stiffness via research that combines computational modeling, advanced fabrication techniques, and mechanical testing.

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Law

LAW

David Abrams

Project 1: Better Bargaining: Machine Learning and Criminal Sentencing

Professor David Abrams is leading a team of researchers who will run a field experiment aimed at using machine learning techniques to increase fairness by reducing disparities in prison sentences. The experiment will be carried out in a Public Defender's Office of one or more major U.S. cities. We are looking for a hard-working, dedicated research assistant (RA) to help make this project a success.

The student will gain experience with a groundbreaking approach known as machine learning, which is revolutionizing industries from Silicon Valley to finance to healthcare to any company that is benefiting from the rise of Big Data. The student will have the opportunity to take part in some of the first research applying machine learning to economic or legal research.

The student will gain experience working with the statistical package STATA and learn a number of research skills that will help the student in future research or industry. The project will also consider the behavioral economics implications of framing information in different ways. Depending on the success of the field experiment, the student will have a role in developing a valuable tool that may drastically improve the fairness of the legal system nationwide.

David Abrams is a Professor of Law, Business Economics and Public Policy at the University of Pennsylvania Law School and the Wharton School. He is also a Senior Fellow at the Leonard Davis Institute of Health Economics. He received his PhD in Economics from the Massachusetts Institute of Technology in 2006, his MS in Physics from Stanford in 2001, and his AB in Physics from Harvard in 1998.

Project 2: Drug Patents, Economic and Health Outcomes

Professor David Abrams is researching innovation in the pharmaceutical industry, and the degree to which the number of times a patent is cited in future patent applications can be used as a proxy for the economic and health value of a patent. Professor Abrams is looking for a hard-working, dedicated research assistant (RA) to help make this project a success.

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In the US alone, pharmaceutical sales were nearly $400 billion last year, and drug costs are among the fastest growing components of U.S. healthcare expenditures. Because of the difficulty of measuring technological progress directly, citation measures are increasingly used by policymakers and researchers to assess the impact of innovation policies. However, there is surprisingly little direct evidence that more highly cited patents are more valuable ones, and existing validation studies have not considered differences between private and social value. In this project, we make use of newly available data on drug efficacy, usage, and revenue to add to our understanding of patent value in the pharmaceutical industry.

The student will help review the academic literature and examine data using statistical software. This opportunity should be of interest to students interested in research, medicine, intellectual property law, or innovation policy.

Project 3: Corporate Board Incentives and Mergers

Professor David Abrams is researching corporate board and CEO compensation and their effects on Merger and Acquisition (M&A) activity. Professor Abrams is looking for a hard-working, dedicated research assistant (RA) to help make this project a success.

The student will have the opportunity to help Professor Abrams start to analyze data he and others have been collecting for several years. The student will gain experience working with the statistical package STATA and learn a number of research skills that will help the student in future research or industry. Responsibilities will include running specification checks and creating tables and figures. This project should be of particular interest to students interested in the empirical analysis of corporate finance.

Claire Finkelstein

Project 1: Ethical Challenges in National Security Reporting

The Center for Ethics and the Rule of Law (CERL) is an academic center that unites preeminent scholars and practitioners from around the world to engage in multi-disciplinary conversations on the legal, ethical, and political issues of war and national security.

CERL offers the opportunity for undergraduates to join the CERL team in timely research and programming on the topic of Ethical Challenges in National Security Reporting. National security reporting has often been a balancing act between the public's right to know about government activity on the one hand, and government's aim to protect confidential information on the other. How has this changed since 9/11? The widespread publication of videos produced

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by terrorists and explicit reporting of extremist violence has troubled many people who worry that shock and awe coverage only adds to public fear and uncertainty. Now there's evidence that media sensationalism is indeed spreading a toxic message which may help terrorists win their propaganda war.

The project consists of in-depth research on the topic and individuals working and contributing to the field, a two-day interdisciplinary conference, follow-up outreach, and publication of an edited volume of original essays.

Students will work under the supervision of Professor Claire Finkelstein and participate in CERL's activities to augment their research skills and learn from a real-world perspective. The project offers the unique opportunity to make critical professional contacts, which may serve to open doors to future job opportunities.

Project 2: Veterans, the Addiction Crisis and the Ethics of Pain Management

The Center for Ethics and the Rule of Law (CERL) is an academic center that unites preeminent scholars and practitioners from around the world to engage in multi-disciplinary conversations on the legal, ethical, and political issues of war and national security.

CERL offers the opportunity for undergraduates to join the CERL team in timely research and programming on the topic of Veterans, the Addiction Crisis and the Ethics of Pain Management. CERL's study of this topic will look at the issue of opioid abuse among vulnerable populations, specifically those suffering from combat trauma, in order to explore solutions for addressing the current addiction crisis in the veteran population as well as to assist in the process of developing guidelines to prevent its reoccurrence with other addictive treatment modalities.

The project consists of in-depth research on the topic and individuals working and contributing to the field, a two-day interdisciplinary conference, follow-up outreach, and publication of an edited volume of original essays.

Students will work under the supervision of Professor Claire Finkelstein and participate in CERL's activities to augment their research skills and learn from a real-world perspective. The project offers the unique opportunity to make critical professional contacts, which may serve to open doors to future job opportunities.

Project 3: Space and the Future of Armed Conflict

The Center for Ethics and the Rule of Law (CERL) is an academic center that unites preeminent scholars and practitioners from around the world to engage in multi-disciplinary conversations on the legal, ethical, and political issues of war and national security.

CERL offers the opportunity for undergraduates to join the CERL team in timely research and programming on the topic of Space and the Future of Armed Conflict. CERL's study of this

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topic will address the current status of space under the law, the potential policies that may govern the use of space in the future, and the legal and ethical norms specific to weapons in space, what the weaponization of space might look like in the future, and the moral and ethical implications of using space technology for national security purposes.

The project consists of in-depth research on the topic and individuals working and contributing to the field, a two-day interdisciplinary conference, follow-up outreach, and publication of an edited volume of original essays.

Students will work under the supervision of Professor Claire Finkelstein and participate in CERL's activities to augment their research skills and learn from a real-world perspective. The project offers the unique opportunity to make critical professional contacts, which may serve to open doors to future job opportunities.

Paul Robinson

Project 1: Bringing Criminal Law Principles and Controversies to a Popular Audience

Empirical research shows that laypersons have very sophisticated intuitions of justice. This project builds upon that innate expertise to bring laypersons into the debates about criminal law rules and their underlying principles. By using a series of carefully selected real-world provocative cases, a popular audience is introduced to the challenges facing criminal law drafters and drawn into the existing debates. This is a particularly important project because American criminal law, unlike any other body of law, is almost exclusively codified. That means that it is crafted by the popular democratic processes within legislatures, rather than by judicial decision making in courts. Thus, the only effective path to the long-term improvement of criminal law is through the education of voters.

The current project agenda calls for finding and developing cases for two planned books: (1) HITLER IN IDAHO: AN INTRODUCTION TO AMERICAN CRIMINAL LAW, which uses criminal cases involving famous people or events over the last two centuries to illustrate how significantly criminal law has changed over that time. (2) SAVING JUSTICE: THE POWER OF COMMUNITY, which uses a series of colorful and dramatic cases to illustrate the many ways in which community involvement is essential to the effective investigation and prosecution of crime.

The undergraduate students' work will involve searching a variety of newspaper, magazine, legal, and other databases and writing up case narratives, guided by regular discussions with Professor Robinson. Particularly useful would be a creative and thoughtful mind and excellent writing skills.

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Medicine

ANESTHESIA

Seema Bhatnagar

Project 1: Investigating the role of the posterior paraventricular thalamic nucleus in habituation to repeated stress

The primary goal of the Bhatnagar laboratory is to understand the neural substrates underlying stress and stress-related psychiatric disorders. One important aspect of the stress response that we study is habituation, a process that is disrupted in post-traumatic stress disorder. Habituation refers to a decreasing response to the same stressor over time. Previous work from our lab has identified the posterior division of the paraventricular thalamic nucleus (pPVT) as a brain region that mediates habituation. We are currently investigating whether neuronal activity-induced expression of specific genes that regulate excitatory synapse number is necessary for habituation. The techniques required to complete this project include immunohistochemistry, behavioral analysis, and brain sectioning. The Bhatnagar laboratory currently employs four postdoctoral fellows and two technicians. Each employee has successfully trained high school and/or undergraduate students in these techniques. The techniques that the PURM students will be trained in serve as excellent stepping-stones for developing scientists. The principles of immunohistochemistry may be applied to a wide range of protein quantification assays (e.g. Western Blot and ELISA). A thorough understanding of the principles required to correctly score the behaviors analyzed in this project can be employed to quantify many other behaviors. Sectioning brains is a useful technique that practically all neuroscientists must learn and helps students develop an in-depth understanding of neuroanatomy. Students will also have the opportunity to present their results at weekly lab meetings throughout the summer, allowing them to develop public speaking skills that will undoubtedly be useful throughout the remainder of their academic and professional career.

Project 2: Assessing the impact of stress on sleep

Stress can impact sleep quality, duration, and architecture. However, there is little known about the neurobiological interaction between stress and sleep. Beyond this, there are potential sex differences in the way we sleep and respond to stress, and thus, the way stress affects sleep. This project aims to examine sleep parameters after stress in both male and female rats. We aim to uncover the neural basis of these differences, with focus on the hypothalamic arousal and stress-related peptides orexins, which are known to be differentially expressed in males and females. In the proposed project, we will implant rats with telemetry devices to assess sleep and body

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temperature parameters after repeated restraint stress. Students will collect primary data while working with animals, assist in surgical and stress procedures, learn the Neuroscore program to assess sleep and body temperature parameters, collate all data, and conduct statistical analyses and present results in lab meetings. Additionally, students will learn to section brains and perform immunohistochemical staining for orexin neural activation. Students will be mentored by a postdoctoral fellow on a day-to-day basis and will be meet with the PI once a week to discuss progress on the project as well as any other issues relevant to the student (career choices, coursework etc.). The lab offers a dynamic and diverse environment and places a high value on a positive and valuable research experience for undergraduate students.

Project 3: Sex differences in adaptations to stress: identifying electrophysiological underpinnings

Women are two times more likely to develop stress-related psychiatric disorders than men. One of the main focuses in our lab is to understand why this is. Previous work in our lab and others suggests that females take longer habituate to repeated stress than males. The paraventricular nucleus of the thalamus (PVT) is critical for habituating to repeated stressors, however, it is unknown if sex differences in PVT neurons contribute to the delayed habituation observed in females. To address this unknown, this project aims to examine the synaptic properties of PVT neurons (ex vivo electrophysiology) in control/stressed, female and male rats. Specifically, spontaneous and miniature, excitatory and inhibitory postsynaptic currents will be recorded in PVT neurons. In this project, students will learn to work with animals, monitor the female estrous cycle and control/stress handle the rats. In addition, they will learn all steps involved in ex vivo electrophysiological recordings. This includes preparing physiological solutions, assist/learn electrophysiology recordings, brain slice histology, and electrophysiology data analysis. Students will be mentored by a post-doctoral fellow and will have regular meetings with the PI. Students will also attend and participate in lab meetings. Mentoring and inspiring undergraduates during their research experience is important aspect of the PURM program, and is a core value in our lab.

Krzysztof Laudanski

Project 1: Assessment of immune system activation long term after sepsis

Recovery from a sepsis remains poorly characterized phenomenon. Functional and developmental plasticity of myeloid cells allows for an optimal adjustment of immune response to post-sepsis milieu. Lost ability of MO to adapt to emerging challenges is seen in several acute conditions but it is unclear whether and how long MO aberrancy can persist. Our study investigated whether persisted activation of myeloid cells is responsible for long-term immuno-aberrations post-sepsis. In this project the individual will be tasked with preparing several histological samples obtain from both wild and humanized mice. Using histological and

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molecular biology techniques student will measure activation of the MO in brain, spleen, kidney and brain and linked them to in vivo traits of immuno-aberrancy. We will focus on both morphological, protein and epigenetic level of immune system activation.

Student at all levels will be accepted as long as they have clear expectation from participation in this project. Student will be tasked in preparing histological samples, maintaining research database, and some data analysis.

Project 2: Attitudes towards decision making in medical field

Medical professionals are faced with making treatment and intervention decisions for their patients on a daily basis. The decisions made could be based on professional experience, personal experience or other logic. In our study we would like to investigate the various components of the decision making process that may influence a person to choose one medical intervention for their patient and different medical intervention for themselves. Our investigation aims to elucidate and describe the components that contribute to the structure and the algorithm of medical decision making. It is especially important to investigate how this relates to end of life care and planning. With the aid of a longitudinal cross over survey we will be able to assess the responses of medical professionals and non-medical professional working in the medical environment in realistic scenarios which they may be faced with.

Project 3: Sepsis and epidemiological consequences of its aftermath

Sepsis affects the recovery of patients long-term. Several disturbances continue after the acute phase of sepsis but it is unclear whether post-septic consequences result in acceleration of natural disease. Our investigation aims at finding if there are epidemiological evidences that survivors of sepsis have acceleration of neoplasms, organ failures or less favorable vaccination rate. This investigation involves processing large database of PennOMINCS data.

In this project student will be tasked with restructuring the database, interacting with PennOMICS department and maintaining research database and initial data processing. CITI certificate is a must but it can be acquired after successful admission to this project.

Frank Leone

Project 1: Postoperative Referral and Connection Program - Postoperative Smoking Cessation

Sometimes one of the only reasons people seek health care is that they have a condition that requires surgery. When a patient arrives to the hospital, medical conditions are frequently discovered that would benefit from long term intervention and follow up. For example,

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sometimes a patient is discovered to be a smoker which can interfere with wound healing, or a patient is discovered to have undiagnosed hypertension.

Our project creates an innovative way to manage chronic illness. As part of a program to create a system for surgical patients to become connected with health resources, we will create a smoking cessation program for people who are found to be smokers the day of surgery. There is evidence that surgery is a “teachable moment”, or an event that motivates individuals to adopt health behaviors.

The student will be primarily involved with recruitment of subjects into the study, and follow up with subjects. Student should be comfortable talking to people in person and via phone. Prior to starting project, student will complete all required training for human research study, hospital orientation, and patient privacy. Training will be provided. Flexibility with work hours and reliability is key.

Our team is comprised of researchers in multiple disciplines:

andrew Wong, MD, Assistant Professor of Anesthesiology.

Sushila Murthy, MD, MPH, Assistant Professor of Anesthesiology.

Jaimo Ahn, MD, PhD, Assistant Professor of Orthopedic Surgery

Frank T. Leone, MD, MS, Associate Professor of Medicine and Director of Penn's Comprehensive Smoking Treatment Program.

CANCER BIOLOGY

Lewis Chodosh

Project 1: Development of a Novel Preclinical Model of Dormant Residual Disease and the Impact of Diet-Induced Obesity on Breast Cancer Recurrence

Breast cancer is the leading cause of cancer-related mortality among women worldwide. The majority of deaths are linked to an inability to effectively manage dormant residual disease and prevent tumor recurrence. Obesity is an increasingly prevalent and modifiable risk factor of disease-specific survival in patients diagnosed with breast cancer. Such provide strong rationale for preclinical studies that enable mechanistic understanding of the pathways through which metabolic control of dormant residual disease may improve oncologic outcomes.

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Using transgenic mice (MTB/TAN) which conditionally express the HER2/neu oncogene, our lab has previously observed that spontaneous breast cancer recurrence is accelerated in mice fed an obesogenic diet, recapitulating human epidemiological studies. Moreover, obese mice randomized to caloric restriction to achieve normalization of body weight have significantly improved rates of disease-free survival, suggesting that the effects of obesity are – at least partially – reversible.

To explore potential mechanisms of these observations, we have started enrollment in a subsequent study using fluorescent-labeled primary tumor cells. GFP-labeled mammary tumor cells injected into lean and obese mice will allow for quantification of the number, distribution, and cell cycle activity of dormant tumor cells that would normally not be clinically apparent. We hypothesize that obesity can accelerate recurrence by either (1) increasing the pool of dormant tumor cells (i.e., greater number) and/or (2) enhancing cell cycle re-entry. Likewise, we hypothesize that caloric restriction will abrogate the effects observed in the setting of obesity.

The student will have a pivotal role in this project. Working closely with Dr. Brett Ecker (Post-doctoral fellow), the student will learn the basics of cell culture (to prepare the GFP-labeled cell population) and flow cytometry (to quantify the tumor cells following resection and cell digestion). There will also be the opportunity, if the student is interested, to practice several skills in the rodent facility (genotypying the transgenic mice, orthotopic injection of tumor cells, etc). No prerequisites are necessary; we can tailor the experience to the student's skills and interest.

Roger Greenberg

Project 1: Mechanisms of Telomere Recombination

The student will investigate mechanisms of telomere recombination that are responsible for telomere length maintenance and cellular immortalization in nearly 15% of human cancers. This will involve in depth studies of telomere associated DNA damage responses, molecular imaging, and techniques to quantify DNA replication

Xiaolu Yang

Project 1: Cellular Systems that Degrade Misfolded Proteins Related to Neurodegenerative Disease

Proteins are the most abundant macromolecules in the cell and are critical to virtually all physiological processes. However, proteins are prone to misfolding, and accumulation of misfolded proteins is genetically and pathologically linked to neurodegenerative diseases and

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cancer. Cells ultimately rely on degradative systems to maintain protein quality. We recently identified a cellular system that selectively degrades misfolded proteins through sequential SUMOylation and ubiquitination, and protects against neurodegeneration. We are further defining the mechanism of this novel protein quality control system, as well as its dysregulation in human diseases.

Students interested in the project would be working closely with lab members to further elucidate the mechanisms involved in protein quality control systems in mammalian cells. The lab is currently exploring several potential therapeutic options for the treatment of well established neurodegenerative diseases which the student would additionally aid in the development of.

Student responsibilities would include learning and developing sterile technique and proper lab bench skills. Students will specifically learn and perform, under guided mentorship, fundamental experiments using biochemistry to test the outstanding questions the group is aimed at understanding. These techniques would include but are not limited to PCR, western blot analysis, mammalian tissue culture, rodent sample preparation/genotyping. The student would also be responsible for organizing and presenting scientific data in a collaborative and critical environment.

Students will work with Lab Manager, Wil Prall to acclimate to the laboratory and transition into a specific project. Students will be paired with post doctorate fellows based upon several variables including students specific interest(s), availability for mentorship, need for assistance on particular projects etc.. Yang Lab currently has nine post doctorate fellows engaged in full-time research projects.

The Yang lab is looking for students are are truly passionate and interested in pursuing a career in research. Our research range stretches wide to include cancer, neurodegenerative disease, apoptosis, and cell metabolism with numerous projects happening at all times creating an intense research environment and incredible opportunity for young scientists to learn and develop skills.

We are specifically interested in ambitious, organized, and focused students who take direction well and have no issue admitting mistakes. Prior lab experience would be ideal but not necessary. Interest in attending graduate school or research as a career is a must.

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CELL AND MOLECULAR BIOLOGY

Shawn Little

Project 1: Genes promoting precision and robustness during cell specification in embryos

Early embryos exhibit single-cell-level precision in establishing specific gene expression programs at precisely defined locations. This precise positioning is reproducible across embryos and is highly robust to fluctuations in environmental conditions such as temperature and nutrients. How do embryos generate robustness and precision in their gene expression patterns? This project will explore the molecular genetic basis of precise patterning in embryos of the fruitfly Drosophila, one of the best studied embryonic patterning systems. The student will use a straightforward genetic screening approach to discover genes that alter the precise positioning of cell fates. The students will set up genetic crosses between strains of different sensitized genetic backgrounds, then use microscopy to look for defects in embryonic patterning and cell fate determination. Ordinarily, embryos from these sensitized backgrounds develop normally. However, embryonic patterning is disrupted when these organisms are challenged by additional genetic perturbation. Further genetic crosses will be used to determine the factor(s) that alter precise patterning. When new factors are identified, the student will assess their effects on gene expression using high resolution single molecule microscopy. The student will receive practical, hands-on experience with Drosophila genetics, embryonic patterning, and high resolution microscopy. These studies will lead to a greater understanding of the molecular basis for gene regulation. No particular prerequisites required, only an interest in embryogenesis and gene expression.

CARDIOVASCULAR MEDICINE

Kiran Musunuru

Project 1: Functional characterization of cardiomyopathy gene mutations

With genome sequencing, many patients are being found to have unique mutations in certain genes that have previously been linked to cardiomyopathies (structural heart diseases) in some people. There is currently no reliable way to determine whether the mutations truly put the patients at risk for a disease, or whether they are benign mutations that are of no concern. My laboratory is working to create a platform in which mutations can be rapidly tested in cardiomyocytes (heart muscle cells) in a dish to see if they are harmful or benign. This

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information will give patients a better sense of whether they are at risk for a cardiomyopathy. The student will work as part of a team in the lab and learn how to introduce mutations into induced pluripotent stem cells with CRISPR-Cas9 genome-editing technology, differentiate the stem cells into cardiomyocytes, and characterize the effects of the mutations on the properties of the cardiomyocytes.

DERMATOLOGY

Elizabeth Grice

Project 1: Characterization of novel natural products derived from the skin microbiome

A position is available to conduct research as part of an ongoing study to identify and characterize secondary metabolites ("natural products") produced by the skin microbiome. The skin microbiome consists of a diverse assemblage of bacteria, fungi, and viruses. Microorganisms are a rich source of bioactive secondary metabolites with unique chemical structure and potent cytotoxic, antitumor, antimicrobial, and anti-inflammatory activity. Over half of approved small molecule drugs in the past 30 years are derived from natural products. We hypothesize that the skin microbiome is a rich, yet almost completely unexplored source of small molecules that: 1) mediate interactions with the host including cutaneous immune responses and/or 2) exhibit antimicrobial activity against cutaneous pathogens. We are conducting a systematic screen to identify skin microbiota-derived small molecules that mediate cutaneous microbe-microbe and host-microbe interactions. Using a combination of microbial genomics, chemistry, and in vitro cell-culture assays, the student will characterize candidate small molecules and assess their functional potential for modulating inflammation of the skin and suppressing colonization and infection by pathogens such as Staphylococcus aureus. The ideal candidate will have some molecular biology laboratory experience and a strong background in biology, chemistry, and/or microbiology. If the candidate has computational skills, they will also have the opportunity to take part in microbial genome assembly and annotation. This is an ideal position for a student that wishes to gain experience conducting research on the human microbiome.

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EPIDEMIOLOGY

Karen Glanz

Project 1: The Impact of Healthy Food Marketing Strategies in Supermarkets Study

The Impact of Healthy Food Marketing Strategies in Supermarkets Study is evaluating the effects of an in-store healthy food marketing intervention on changes in sales and purchases of healthier food items. This study is being conducted in 32 supermarkets in urban, low-income, high-minority neighborhoods in PA, NJ, and DE. Shoppers complete food marketing surveys in stores and a subset of shoppers return grocery store receipts before and then 6, 12, 18 and 24 months after the intervention strategies are implemented. Observational data is collected to evaluate the store nutrition environment and to ensure compliance with the intervention. Weekly store sales are the primary measure for evaluating the healthy food marketing strategies intervention. Students working on this project will work closely with the project team, including the project manager, project coordinators, and research assistants.

Specific responsibilities for this project include: traveling to designated supermarkets to recruit study participants and interview them about their food shopping habits, following up with shoppers to collect grocery store receipts, completing observational data collection in the designated supermarkets, preparing fieldwork materials, data entry, data cleaning, logging, coding and other duties as assigned. Students must be comfortable traveling (with a team) to the designated supermarkets, have proficiency in Microsoft Office, and should be interested in the measurement of health behavior and/or theoretical basis of understanding health behavior.

Jason Moore

Project 1: Development of novel visualization methods using video game engines

We have previously used the Unity 3D video game engine to visualize high-dimensional biomedical data (see https://www.ncbi.nlm.nih.gov/pubmed/21121043). We are looking for students to continue this work and to adapt it to other projects. Experience with computer programming is required. Experience with video game programming is an asset but not required. The student will work Dr. Moore and a visualization programmer in the lab to complete the project. Access to the new visualization laboratory at the Institute for Biomedical Informatics at PSOM is part of the project.

Project 2: Automated machine learning

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We have developed a new method for automating the construction of machine learning pipelines for the analysis of biomedical data. We are looking for students to assist with the development of extensions to the method and to carry our computational experiments for evaluating the approach. More information can be found here: https://github.com/EpistasisLab/tpot. The student would work directly with Dr. Randal Olson, senior data scientist. Python programming skills required.

Project 3: Accessible artificial intelligence

The Institute for Biomedical Informatics at PSOM is developing an accessible artificial intelligence system for the analysis of biomedical data. This project is in the early stages of development for a Fall 2017 launch. A student project is available to help test and perhaps help contribute ideas and methodology to this project. The student would work with a team of faculty, students, and programmers developing these new methods and infrastructure. Computer programming skills (Python) desirable but not absolutely necessary.

FAMILY AND COMMUNITY HEALTH

Frances Barg

Project 1: Research with the Guatemala Health Initiative

We are seeking one to two promising students who will work long term with the Guatemala Health Initiative to conduct research in the rural highlands of Guatemala. Since 2005, the Guatemala Health Initiative (GHI) has coordinated interdisciplinary research, education, and service programming involving the School of Nursing, School of Medicine, School of Arts and Sciences, Wharton, and the School of Engineering and Applied Sciences. GHI partners with the Hospitalito Atitlán (HA) in the Mayan communities of Santiago Atitlán, Guatemala and the Centro de Salud in San Juan Sacatepequez, Guatemala to develop and organize community initiated programs aimed toward improving the health of the community.

In this position, each student will work with faculty and community partners on one of three projects: a community health needs assessment in San Juan Sacatepequez, a diabetes screening, treatment and community education program, or a project addressing anemia on fincas in the rural districts surrounding Santiago Atitlan. In each of these projects, students will be responsible for primary data collection and data management. Students will learn interviewing skills, database management skills and qualitative research skills. In addition, students will gain important perspectives on factors affecting the implementation of global health programs. Students will spend 10 weeks in Guatemala in a home-stay, screened by the GHI. Spanish

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language skills are required. Students work under the direction of Dr. Fran Barg, a medical anthropologist and Dr. Kent Bream a family physician and global health specialist.

Kent Bream

Project 1: Sayre Health Center Community Health Research

The Sayre Health Center is a community health center located at 59th street in West Philadelphia. The health center seeks student research assistants to implement and analyze an ongoing community health survey. In 2017 we will focus on Type II diabetes and methods to increase awareness, diagnosis, and control. Students should have an interest in health in underserved US populations and have an basic understanding of the "social determinants of health" as background to this work. Research assistants will work with qualitative and quantitative data to understand the biomedical and perceived health needs of the Cobbs Creek community surrounding Sayre Health Center. Specifically we will examine the knowledge, beliefs, and practices around diabetes.

The PURM student will serve an essential role in preparing a report describing the results of the survey and working to change the impact of diabetes in the community. Mentoring will be provided by the PI and Medical Director, Kent Bream as well as the Outreach staff of the health center. Students will work side by side with community members on a daily basis.

GASTROENTEROLOGY

Rotonya Carr

Project 1: The role of ceramide synthase in alcoholic liver disease

Alcoholic liver disease (ALD) is the major cause of liver related morbidity and mortality worldwide and the second leading indication for liver transplantation in the US; however treatment options are currently limited due to an incomplete understanding of the molecular drivers of ALD pathogenesis. We have developed biologic tools to investigate the role of ceramides as unconventional co-factors in alcoholic steatosis, the earliest stage of alcoholic liver disease (ALD). The research uses novel in vitro and in vivo model systems to investigate the hypothesis that the enzyme ceramide synthase 6 (CerS6) promotes the development of alcoholic steatosis through upregulation of the key hepatic lipid droplet protein, Perilipin 2 (PLIN2). The researcher aims to 1) investigate the regulation of PLIN2 by CerS6 and functional role of hepatic-specific CerS6 deletion in glucose and lipid homeostasis in alcoholic steatosis and 2)

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examine the relative expression, localization and zonation pattern of hepatic CerS6 protein expression in each stage of human ALD; and test the potential of CerS6-specific ceramides as plasma biomarkers for ALD.

We will use genetically engineered human ethanol-metabolizing VL17-A cells and CRISPR/Cas9 genome edited mice. A combination of comprehensive in vivo metabolic phenotyping, lipidomics analyses, and biochemical and functional assays will be performed to establish the role of CerS6 in alcoholic steatosis. In addition, we will examine the contribution of CerS6 in human liver pathology by correlating its protein expression and synthesized ceramides with pathology in liver tissues of patients with ALD. Results of this project will lay the foundation for examining the mechanistic role of ceramide synthetic pathways in the regulation of PLIN2, data that will ultimately be used to identify molecular signatures of liver disease risk and progression in patients at risk for ALD.

The rotating student will be mentored by the PI (Rotonya Carr, MD (a hepatologist) and post-doc (Jason Correnti, PhD) to gain expertise in a wide array of biologic applications including molecular biology, lipid assays, in vivo physiology and cell culture. Students will learn how to feed mice alcohol and there will also be opportunity to extend studies to human tissues. Students will be expected to come to lab daily to perform experiments and participate in lab meetings where research is presented. Students should have a strong foundation in biology and biochemistry.

Project 2: The role of acid ceramidase in experimental alcoholic liver disease

Alcoholic liver disease (ALD) is the major cause of liver related morbidity and mortality worldwide and the second leading indication for liver transplantation in the US; however treatment options are currently limited due to an incomplete understanding of the molecular drivers of ALD pathogenesis. Ceramides (sphingolipids) are increased in the livers of ALD patients and promote disease progression. This project will determine the effect of hepatic ceramide enzyme, acid ceramidase, on the development of the earliest stage of alcoholic liver disease, alcoholic steatosis. We will use a combination of novel genetic, molecular biology and pharmacological approaches; lipidomics analyses; and metabolic phenotyping to understand the in vivo functional consequences of our models. These studies will advance our understanding of the contribution of lipids and associated proteins per se to alcohol liver pathology and can provide insight into early targets for therapeutic intervention.

The rotating student will be mentored by the PI and post-doc (Dr. Jason Correnti) to gain expertise in a wide array of biologic applications including molecular biology, lipid assays, in vivo physiology and cell culture. Students will, also, learn how to feed mice alcohol. Students will be expected to come to lab daily to perform experiments and participate in lab meetings where research is presented. Students should have a strong foundation in biology and biochemistry.

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GENETICS

Laura Almasy

Project 1: Genomics of Addiction

According to the 2015 National Drug Use and Health survey, over 15 million adults in the US have an alcohol use disorder and alcohol-related fatalities are the fourth leading cause of preventable deaths. It is well established that genetics and environment both contribute to risk of alcohol use disorders and it has been estimated that children of individuals with alcoholism are at 2- to 4-fold higher risk of developing the disorder. The Collaborative Study on the Genetics of Alcoholism (COGA) seeks to identify genetic components of risk and characterize their actions and their interactions with environmental risk factors. COGA has data on over 17,000 individuals, including clinical diagnoses, symptom profiles, electrophysiological brain wave measures, and measures of psychological test performance. This project will involve analysis of exome sequence data and electrophysiological measures from families that include a high density of individuals with alcoholism. This “dry lab” project is well suited to students with a basic knowledge of genetics and an interest in learning novel methods of computational analysis. The student who works on this project will learn techniques for analysis of human genome sequence and genetic analysis methods for quantitative phenotypes, analyzing genome sequence in a chromosomal region previously linked to variations in brain waves in these high-risk families. Data is already in hand and ready for immediate analysis. Students will have a chance to interact with COGA investigators across the US and will be invited to be a co-author on publications and presentations reporting the results of these analyses.

Project 2: Sex and the Brain

Variations in brain structure and function have been linked to a wide range of psychiatric disorders, including autism, schizophrenia, depression, and alcoholism. These disorders all have genetic components and many of them have disparate frequencies in males and females, raising the possibility that genotype-by-sex interaction (GxS), in which the nature or magnitude of genetic effects differs in males and females, partially explains these differences in prevalence. This project will involve examining GxS in brain-related measures in data sets collected to study schizophrenia, addiction, and normal variation in brain structure and function. Available phenotypic measures include cognitive test performance, functional and structural MRIs, and electrophysiological measures. These will be tested for global GxS, asking the question of whether the magnitude or source of aggregate genetic effects varies across the sexes. For phenotypes with evidence of global GxS, we will examine differences between males and females in genetic effects at particular genomic loci, drawing on genome-wide genotyping and exome and whole genome sequence data sets available in these studies. This “dry lab” project is

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well suited to a student with a basic knowledge of genetics and an interest in learning novel computational techniques. The student will learn techniques for statistical genetic analysis of quantitative risk factors and methods for genome-wide association studies and human genome sequence analysis. She or he will have an opportunity to interact with investigators in several different national collaborations and will be invited to be a co-author on publications and presentations reporting the results of these analyses.

Arupa Ganguly

Project 1: Epigenomic characterization of uveal melanoma

Uveal melanoma (UM) is a rare but deadly disease; 50% of patients develop metastasis within 5 years, and subsequently succumb to the disease within one year. UM affects the uveal tract of the eye, and is genetically distinct from cutaneous melanoma. Commonly occurring DNA alterations (e.g. point mutation and copy number aberrations (CNA)) are well-characterized in these tumors, but there has been little investigation into the role of epigenetics in tumor development or progression. We initiated a pilot project to characterize DNA methylation across the genome of 24 UM tumors with thorough clinical annotations and established genome-wide CNA profiles.

This project will involve two components. First, the student will evaluate preprocessing strategies using existing bioinformatics software. Next, several questions are pending. Are there differentially methylated sites in UM tumors compared to controls? Between tumors that have or have not metastasized? Can these features predict patients likely to develop metastasis? Are there methylation subtypes? How do these features relate to well-known DNA alterations (point mutations and CNAs)?

This project provides an opportunity to work on a cutting-edge cancer genomics and precision medicine project to be published in a peer-reviewed journal. The student will learn bioinformatics techniques, how to perform statistical analyses, including machine learning if interested.

Skills:

- Some programming experience (ideally R or python, and bash)
- Experience in cancer biology or genetics is not necessary, but helpful.
- Experience in statistics or machine learning a bonus

Mentor:

Arupa Ganguly, PhD

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Emilie Lalonde, PhD

Sarah Tishkoff

Project 1: Characterization of Genomic Variation in Ethnically Diverse Africans

Africa is thought to be the ancestral homeland of all modern human populations within the past 200,000 years. It is also a region of tremendous cultural, linguistic, climatic, and genetic diversity. Despite the important role that African populations have played in human history, they remain one of the most underrepresented groups in human genomics studies. A comprehensive knowledge of patterns of variation in African genomes is critical for a deeper understanding of human genomic diversity, the identification of functionally important genetic variation, the genetic basis of adaptation to diverse environments and diets, and the origins of modern humans.

We have generated high coverage whole genome sequence data from ethnically diverse Africans. We are using computational approaches to characterize single nucleotide variants, structural variants, and regulatory variants and to determine their functional impact on adaptive traits and disease risk.

The student working on this project will assist with analyzing high coverage whole genome sequence data from ethnically diverse African populations. Using the assembled genomes, we can construct accurate haplotypes which are key to the understanding of demographic history and selection pressures in Africa that shape the current genomic diversity. Competitive candidates will have strong computational skills and, ideally, a strong understanding of biology. This is an ideal position for a student who wants to obtain experience doing bioinformatics analysis.

Project 2: Identification and characterization of regulatory variants influencing adaptive traits in ethnically diverse Africans

Regulatory variation plays an important role in shaping phenotypic variation, including disease susceptibility and adaptation to diverse environments. However, astonishingly little is known about regulatory variation in Africa, a region with the highest levels of genetic diversity on a global scale. Our lab is integrating genomic and transcriptomic data to identify regulatory variants that play a role in human evolution and adaptation to diverse diets and environments in Africa.

The student working on this project will assist with functional genomic studies of candidate regulatory variants that play a role in adaptive traits. The project will involve targeted DNA sequencing, cloning and in vitro luciferase expression assays and/or CHIP- seq/ATAC-seq in appropriate cell types. A qualified candidate will have a background in genetics or molecular biology and will have some laboratory skills. If the applicant has computational skills, there will

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also be an opportunity for doing computational analyses of gene regulation. This is an excellent opportunity to obtain experience in human genome research.

Golnaz Vahedi

Project 1: Analytical tools for single-cell epigenomic mapping in immune cells

Our lab is interested in mapping the epigenomic alterations of T cells in health and disease. Recently, we purchased an automated microfluidic solution for single-cell genomics. Our lab is able to capture single T cells using this platform; our preliminary data support the feasibility of generating genome-scale chromatin accessibility maps (single-cell ATAC-seq) in single T cells. Yet, single-cell genomics data are sparse and analytical techniques are required to evaluate technical variability from biological variability. This project aims to use single-cell genomics data generated in our lab to ultimately devise mathematical approaches to delineate signal from noise. We would like to further implement such a method in programming languages like R and allow the community to access it for their need. The prerequisites of this project are programming skills (R, Perl, or Linux) together with backgrounds in mathematics, probability theory and statistics.

HEMATOLOGY/ONCOLOGY

Mark O'Hara

Project 1: Personalizing care for pancreatic cancer patients through next generation sequencing of circulating tumor cells and circulating tumor DNA

The Circulating Tumor Material (CTM) Lab, led by Dr. Erica Carpenter, MBA, PhD and in collaboration with Dr. Mark O'Hara, MC, develops and implements cutting edge technologies to support the delivery of personalized medicine to patients with cancer. Our research is clinical and translational in nature. Translational research applies discoveries from basic science to a clinical context, allowing a student to explore both dimensions of biomedical research simultaneously. We focus on the identification, capture, and analysis of Circulating Tumor Cells (CTCs) and cell-free DNA (cfDNA) from blood, bone marrow, pleural effusion, and other non-invasively captured patient samples. These approaches allow: 1) early detection of disease as well as post-therapy monitoring of minimal residual disease, 2) a means of determining clinical response to therapy and, thus, clinical decision making, and, 3) cancer genetic phenotyping to drive personalized medicine that obviates the need for serial biopsies in a population of patients for which these procedures are difficult, risky, and insufficient. The focus of the CTM Lab is

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driven by the needs of translational investigators and clinicians, such as Dr. O'Hara, and realized through collaborative work with investigators in the Penn School of Medicine, the Penn School of Engineering, and the Center for Personalized Diagnostics. Moreover, when it is determined that outsourcing of technology development is preferable, collaborative efforts with industry partners are actively sought. Here, the student will focus on the development of highly sensitive approaches for the isolation and next-generation sequencing of cell-free tumor DNA and CTCs isolated from the blood of pancreatic cancer patients enrolled on clinical trials. The student will conduct assay development, perform sample preparation, and summarize/analyze results. The student will also be exposed to the clinical aspects of pancreatic cancer patient treatment, including participation in meetings (called Tumor Boards) to review next-generation sequence data and its clinical implications. There will also be clinical shadowing opportunities with Dr. O'Hara and other collaborating physicians in addition to opportunities to participate in studies of other cancer types. The student will be co-mentored by Drs. Carpenter and O'Hara with full-time touchdown space in the Carpenter lab. This is an ideal project for a student who is interested in medical science, but may be undecided between medical and graduate school, and would like to gain experience in both translational and clinical research.

MEDICINE

Lawrence Brass

Project 1: Spatio-temporal regulation of platelet activation following vascular injury in vivo

We recently determined that hemostatic plugs formed following vascular injury in vivo are composed of discrete regions with variable degrees of platelet activation. Ongoing studies are investigating how multiple components of the platelet signaling network are integrated to produce this heterogeneous hemostatic plug architecture. To accomplish these goals, we make extensive use of multiple systems for examination of thrombosis in vitro and in vivo, including a spinning disk confocal intravital microscopy system for visualization of thrombosis in the microcirculation of mice. Intravital microscopy approaches also involve the use of established and novel fluorescent probes for visualizing various aspects of the hemostatic response in vivo, including fluorescently labeled antibodies, fluorescent biochemical activity sensors and genetically encoded fluorescent indicators.

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Project 2: The influence of local microenvironments on hemostasis and thrombosis in vivo

In conjunction with the studies in Project 1, we have become interested in how local microenvironments within a platelet aggregate help to shape the movement and overall distribution of soluble plasma components that regulate platelet activation and coagulation. These studies couple in vivo imaging approaches measuring solute transport with in vitro and computational approaches to model and analyze the physical characteristics of the microenvironment between adjacent platelets as they become tightly packed in a hemostatic plug.

Project 3: Platelet function in the setting of trauma and other pathologic states

Platelet function is known to be perturbed in a number of pathologic settings and may contribute to the morbidity and mortality associated with these pathologies. One example is in the setting of trauma, where a subset of severe trauma patients develop a coagulopathic state characterized by abnormal blood clotting and excessive hemorrhage. We are using animal models to study platelet function in the setting of trauma-induced coagulopathy as part of a multi-institution consortium funded by the NHLBI (TACTIC).

MICROBIOLOGY

Hao Shen

Project 1: Vaccine against bacterial pneumonia

Pneumonia caused by Streptococcus pneumoniae (Sp) remains a leading cause of serious illness and numerous deaths in children and elderly worldwide. Current pneumococcal vaccine is effective in preventing colonization by inducing serotype -specific antibodies. However, there is an increasing prevalence of infection by serotype strains not included in the vaccine; this highlights the need for a universal vaccine that protects against all serotypes. In our recent studies, we have found that mice intranasal immunized with Sp are protected against challenge with a different serotype Sp strain. Sp infection in lung results in a tremendous CD4+T cell expansion and activation that consisted of mostly IL-17 producing Th17 cells. Adoptive transfer of Sp-specific CD4+ memory T cells provides cross protection against pneumonia and bacteremia, and the protection is dependent on IL-17 produced by memory CD4 T cells. Our results suggest that Sp memory Th17 cells played a key role in providing broad protective immunity against invasive Sp infection in a serotype independent manner. This PURM project

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seeks to expand on our findings by testing clinical isolates of Sp and analyzing the resulting immune response. The student will culture bacteria and learn how to use a mouse model of Sp infection with clinical isolates and analyze the immune responses using flow cytometry. The results of these studies could be instrumental in developing a universal vaccine against bacterial pneumonia.

Jay Zhu

Project 1: Study of gut microbiome effects on colistin-resistant enteric bacteria

The evolution and widespread distribution of antibiotic-resistance elements in bacterial pathogens has made diseases that were once easily treatable deadly again. Recently, this issue heated up dramatically with the spread of colistin (often considered to be a last-resort antibiotic) resistant Escherichia coli in the United States and abroad over the summer. Our lab is currently study molecular mechanisms of the pathogenesis of multi-drug resistant Klebsiella pneumoniae. We found that members of gut microbiome and oxygen tension greatly affect colistin resistance of K. pneumoniae. The summer project will apply classic genetics and cutting-edge highthroughput sequencing to dissect the underline mechanisms of bacterial cell-cell communication that modulates antibiotic resistance efficiency. Prior lab experience is preferred. I myself will mentor the student directly with the help from a PhD student (Yitian Zhou).

NEUROLOGY

Ramon Diaz-Arrastia

Project 1: Cerebrovascular reactivity assessed with functional near-infrared spectroscopy as a biomarker of traumatic microvascular injury after moderate-severe traumatic brain injury

Traumatic cerebrovascular injury (TCVI) is common after traumatic brain injury (TBI) and an attractive target for therapeutic intervention. We will longitudinally measure cerebrovascular reactivity (CVR) by functional near-infrared spectroscopy (fNIRS) in acute (≤3 days from injury), subacute, and chronic phases after TBI as a biomarker of TCVI as compared to healthy controls.

CVR will be measured by fNIRS response to hypercapnia. We hypothesize that CVR will be decreased after TBI and that these decreases will correlate with clinical outcomes. Furthermore,

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we predict that administration of a vasodilatory medication (sildenafil) will augment CVR after TBI.

Objectives:

1. To longitudinally measure CVR via fNIRS with hypercapnia challenge in 143 TBI patients in the acute, subacute, and chronic phases after injury and 25 age-matched peer controls without TBI.

2. To correlate TBI-related CVR changes with clinical neuroimaging and post-concussive symptoms measured by survey questionnaires, neurological examination and cognitive testing.

3. To measure changes in CVR longitudinally before and after single dose administration of a phosphodiesterase 5 inhibitor, sildenafil citrate, in the acute, subacute, and chronic phases after TBI and in healthy controls.

Student would be responsible for administering short questionnaires, data entry, data analysis and learning how to use FNIRS technology.

Dr. Michael Sangobowale will directly mentor and supervise students working on the project.

Ethan Goldberg

Project 1: Role of VIP-positive interneurons in epilepsy

Students will participate in a project investigating the role of a specific subtype of inhibitory neuron (those immunopositive for the neuroactive peptide vasoactive intestinal peptide, or VIP) in cerebral cortical circuit function and in the potential role of VIP-positive interneuronal dysfunction in an experimental animal model of a severe pediatric epilepsy. Students will work alongside the PI and/or a post-doctoral fellow or graduate student in the laboratory, and learn and implement such techniques as immunohistochemistry and brain tissue processing, stereotaxic injection of adeno-associated viruses into brain, two-photon calcium imaging, optogenetics, and/or cellular neurophysiology, depending upon experience and aptitude. Students will attend weekly lab meetings and journal clubs and will prepare and present a lab meeting at the end of the summer. Some prior experience with biological research (animal handling/behavior, microscopy, and/or physiology), data analysis/computer programming (Matlab, Java, Python, etc), or engineering background, is required.

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Brian Litt

Project 1: Fabrication and characterization of microfluidic platforms for neural recording and stimulation in vivo

Understanding the dynamics of brain networks underlying thoughts, actions, perception and disease requires monitoring neural in vivo over several months. State-of the-art metal and silicon microelectrode arrays can record from neural circuits at millisecond resolution over the course of relatively transient behaviors. However the size and stiffness of these devices triggers a foreign body reaction in the brain tissue that dramatically reduces their viability over long timescales unless they are repositioned. Smaller, flexible electrodes have improved recording stability and reduced foreign body response. Yet there are currently no technologies to insert these electrodes without stiffeners that produce acute damage.

In the Litt Lab, we have developed a new microfluidic-actuated electrode technology in which ultra-small, flexible microelectrodes are used to chronically monitor and stimulate neurons in vivo, while causing minimal damage to the brain. The project will involve: 1) fabrication of the microfluidic devices in the Penn Singh center, 2) characterization of the electrical and flow properties of the device in vitro, 3) data analysis using Matlab.

This project is intended for a student interested in learning more about neuroengineering and potentially looking for a longer-term research experience to extend into the academic year. Some prior wet lab, fabrication, or MATLAB coding experience is preferable. Dr. Flavia Vitale will also provide mentoring for this project.

Project 2: Fabrication and characterization of transparent graphene electrodes for studying neural circuits

The development of devices to record and stimulate neural circuits has led to breakthrough discoveries on the connectivity and functionality of the brain in healthy and diseased states. Though great advances have been made in implantable electrode technology, there still exists a significant trade-off between achieving high spatial resolution and scaling the devices up to monitor large brain areas. Optical recording techniques, which rely on calcium or voltage-sensitive fluorescent reporters, offer the ability to monitor thousands of individual neurons simultaneously. However, these techniques do not offer the temporal resolution necessary to decode the firing patterns of the neural circuits. The combination of high temporal resolution electrophysiology recording with high spatial resolution optical recording offers the potential to study neural networks in unprecedented ways and greatly enhance neuroscience research. The Litt Lab is currently developing a transparent, flexible neural electrode technology based on graphene, a material with excellent optical and electrical properties. In collaboration with the Coulter lab, we will utilize these devices in mouse models to see how epilepsy affects the circuits involved in learning and spatial navigation. The project will involve device fabrication and

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characterization of the in vitro electrochemical properties of the electrodes as well as analysis of in vivo optical and electrophysiological recordings using MATLAB. This project is intended for a student interested in learning more about neuroengineering and potentially looking for a longer-term research experience to extend into the academic year. Some prior wet lab, fabrication, or MATLAB coding experience is preferable. Dr. Flavia Vitale will also act as a mento on this project.

NEUROSCIENCE

Joshua Gold

Project 1: The relationship between arousal and coordinated neural activity

Arousal can profoundly affect learning, attention, and other aspects of higher-brain function, but little is known about the underlying neural mechanisms. My laboratory has several ongoing projects that are testing the hypothesis that these effects arise, at least in part, from arousal-mediated changes in coordinated neural activity throughout the brain.

This project involves analyzing complex data sets that we are in the process of collecting from monkeys. These are among the most comprehensive data sets ever collected that combine measures of arousal (pupil diameter, heart rate, and EEG) with measures of neural activity (from the brainstem nucleus locus coeruleus, or LC, which mediates arousal, and several of its cortical and subcortical targets). Because of the complexity of these data sets, analysis must be done in stages. The goal of this project is to tackle one stage of this analysis process, likely to involve relating a single arousal measure to a single neural measure. These analyses will be integrated with other, ongoing analyses to create a comprehensive picture of the relationship between arousal and coordinated activity throughout the brain.

This project would benefit from a student with strong quantitative skills and proficiency with Matlab.

This student will also be mentored by Dr. Siddhartha Joshi, a post-doctoral fellow who is leading this project.

Project 2: Relating arousal to neural activity in ECoG recordings

Arousal can profoundly affect learning, attention, and other aspects of higher-brain function, but little is known about the underlying neural mechanisms. My laboratory has several ongoing projects that are testing the hypothesis that these effects arise, at least in part, from arousal-mediated changes in coordinated neural activity throughout the brain.

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This project involves collecting a novel data set relating pupil diameter, a measure of arousal, with neural activity recorded from human epilepsy patients using electrocorticography (ECoG). The goal of this project is to help to collect and analyze these data sets to identify pupil-linked changes in coordinated activity throughout the brain.

This project would benefit from a student with strong quantitative skills and proficiency with Matlab.

This student will work directly with Chris Pizzica, a research technician in the Gold laboratory.

Project 3: Pupil diameter as a biomarker of tauopathy-related degeneration of the locus coeruleus

Frontotemporal lobar degeneration (FTLD) is a spectrum of neurodegenerative diseases that result in progressive behavioral, language, and motor dysfunction. FTLD can be classified into two major pathologies that are associated with a buildup two different proteins in the brain ("proteinopathies"): those with intracellular aggregations of the microtubule binding protein, tau (FTLD-tau), and those with inclusions of the DNA-binding protein TDP-43 (FTLD-TDP). Unfortunately, for many patients the specific form of the disease can only be distinguished post mortem, which denies us the capability to provide them with the treatment best suited to their specific FTLD affliction.

Among the brain areas heavily affected by FTLD-Tau, but not FTLD-TDP, is the locus coeruleus (LC). Therefore, a biomarker of LC function could be used to distinguish FTLD-Tau from TFLD-TDP and other forms of FTLD. The goal of this study is to determine if and how measures of pupil diameter, which have been shown to reflect LC function in healthy subjects, can be used as such a biomarker. The student will help design and test a battery of tasks designed to evoked LC-mediated changes in pupil diameter, which will then be used to test FTLD patients.

This project would benefit from a student with strong quantitative skills and proficiency with Matlab.

This student will also be mentored by Dr. Hannah Lefumat, a post-doctoral fellow who is leading this project.

David Irwin

Project 1: Progression of tau pathology in non-amnestic Alzheimer's disease

This project examines the post mortem distribution of tau pathology in patients with non-amnestic syndromes associated with Alzheimer's disease neuropathology using digital image

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analysis methods. Students will learn skills in histology, digital image analysis and statistics. Responsibilities include using software to segment and color deconvolute images of histology slides to measure staining of tau and related neurodegnerative disease proteins and relate these measurements to ante mortem neuropsychological testing. Students will gain experience with digital image analysis techniques, histology of neurodegenerative disease, neuropsychological testing and statistical analyses. Students will also have the opportunity to join journal clubs and shadow in neurodegenerative disease cognitive clinic.

Project 2: Alzheimer's disease pathology in Lewy body disease

Previously we found evidence of a dose-dependent association of post mortem severity of Alzheimer's disease pathology on the onset of dementia and overall survival in Lewy body disorders (Parkinson's disease, Dementia with Lewy bodies). This project will use new digital image analysis methods to quantify the burden of Alzheimer's disease associated tangles and plaques, along with Lewy body disease related synuclein inclusions, in human brain tissue and examine clinical correlates of these, including ante mortem neuropsychological testing. Students will gain experience with digital image analysis techniques, histology of neurodegenerative disease, neuropsychological testing and statistical analyses. Students will also have the opportunity to join journal clubs and shadow in neurodegenerative disease cognitive clinic.

Project 3: Frontotemporal dementia in Amyotrophic Lateral Sclerosis

It is known that up to 30% of all patients with Amyotrophic Lateral Sclerosis (ALS) have cognitive impairment on onset of disease and many have sufficient impairment to meet criteria for frontotemporal dementia. This project aims to measure the burden of TDP-43 pathology in the non-motor regions of the brain in ALS patients and relate to ante mortem cognitive testing to develop tests that can predict dementia in ALS. Students will gain experience with digital image analysis techniques, histology of neurodegenerative disease, neuropsychological testing and statistical analyses. Students will also have the opportunity to join journal clubs and shadow in neurodegenerative disease cognitive clinic.

Michael Platt

Project 1: Neurogenetics of social behavior

Our research combines intensive field observations of monkey social behaviors with cutting-edge genomics techniques to produce an unprecedented dataset of genes and behavioral patterns. This work allows us to discover how genes and the environment interact to influence social behavior. Because the genomes of monkeys and humans are so similar, we can use our findings in monkeys as a guidepost for understanding the genetics of, and possible treatments for, disorders of social behavior in humans. This is an invitation for two undergraduate students to

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join as researchers on a project studying the genetic correlates of behavior, cognition, and health in a population of rhesus macaques living on Cayo Santiago island, Puerto Rico. Students will be trained in various computational and statistical packages to develop skills in the field of bioinformatics. In doing so, PURM researchers will incorporate the use of population genomic data to assess the biological impacts of genetic variants on associated animal phenotypes. More specifically, we are interested in how social and genetic variation might impact social proximity scores: Are the genetic correlates of autism spectrum disorder in humans associated with social proximity scores in the primate population? This project is suitable for any biology, biological anthropology, psychology, neuroscience or computer science major with strong quantitative skills and an interest in the biological mechanisms that underlie decision-making in social environments. Students can expect to be exposed to a multitude of research projects concurrently run in the lab across these disciplines.

Project 2: Harnessing the Social Brain to Increase Clinical Trial Participation

The idea is to increase participation in clinical trials for cancer treatments by increasing trust and/or loyalty to either the physician, the hospital, or both. In a pilot study we will explore, behaviorally and neurobiologically (i.e., fMRI, EEG and eye tracking), how people connect with, and build trust with, a physician, a hospital, or both and whether that would predict likelihood of joining a clinical trial. Students will be engaged in study design, data collection, and analysis and implementation of outcomes.

Project 3: Synchronized Arousal in Social Decision Making

The central question is whether individuals pick up cues to another individual's state of arousal, and can use that information to update their own behavior. So, rather than observing other's explicit behavioral responses we ask whether they can infer it, instinctively, from peripheral physiological cues like pupil dilation and facial expressions. Partners play across a shared screen , foraging by pointing to say one of 4 patches, which are dynamically varying in payout. They take turns. We vary whether partners have access to the other individual's face or only eyes (via smart glass). We might provide a cue to each individual privately (say behind the head of the partner) about what their payout will be. We measure pupil response in the subject in response to the partner getting information about her own reward, either directly or indirectly. This is a question about synchronizing arousal.

Moving forward, we will ask whether subjects can update and change their own responses based on arousal feedback. This study could have broad implications for decision making in groups, including the military, homeland security, and negotiations.

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Jonathan Raper

Project 1: Identification of axonal guidance factors in the zebrafish olfactory system

Our laboratory is studying how neuronal circuits form in the brain during development. Using a combination of molecular biology, embryology, and advanced imaging techniques, we are identifying axonal guidance cues that determine the specific target locations of axons within the developing olfactory system of zebrafish. We are seeking undergraduates to help us analyze the accuracy of olfactory sensory axon targeting in lines of fish that have mutated candidate axonal guidance factors. No previous lab experience is required, but a strong interest in science is essential. After a training period, students will take the lead on their own project. This position is most suitable for one or two students interested in a longer term commitment leading to a senior honors thesis.

NEUROSURGERY

Zarina Ali

Project 1: Neurosurgery enhanced recovery after surgery

Though significant advances have been made in neuroanesthesia and perioperative neurosurgical care, spinal surgery still often results in significant postoperative morbidity. Excluding complications related to anesthesia or surgery, the surgical stress response with its increased metabolic demands on the body serves as a critical pathogenic factor in postoperative morbidity. Introduced in 1997 by Henri Kehlet, Enhanced Recovery after Surgery (ERAS) proposes a multimodal, evidence-based approach to prepare patients for surgery. The principles of ERAS have been implemented for a variety of surgeries. The evidence to support ERAS with regards to major spinal surgery has been proposed to enable patients a faster recovery and to lower surgical morbidity. Application of ERAS in the neurosurgical arena has the potential to enhance productivity gains and cost savings. However, explicit guidelines are lacking for the neurosurgical spinal patient. We propose to study a prospective cohort of patients undergoing spinal surgery to assess the feasibility and efficacy of a novel ERAS protocol in the neurosurgical population in order to improve postoperative patient satisfaction as well as clinical/functional status.

Students interested in this project will be required to review patient data and surgical outcomes and assist with statistical analysis and manuscript preparation under the mentorship of a research team.

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Project 2: Peripheral nerve surgery outcomes research

This project is intended to retrospectively review the outcomes from a variety of peripheral nerve surgeries and assess patient outcome. Students interested in this project will be required to review patient data and surgical outcomes and assist with statistical analysis and manuscript preparation under the mentorship of a research team.

H. Isaac Chen

Project 1: Defining the phenotype and axon targets of transplanted cerebral organoids

The human brain has a limited capacity for repairing itself after injury. Especially after severe brain damage, the addition of new neurons may be necessary to effectively restore neurological and cognitive function. Cerebral organoids are 3D neural tissues that are derived from pluripotent stem cells. Importantly, cerebral organoids mimic the architecture of the brain, including the development of rudimentary cortical layers. The potential for using cerebral organoids to repair injured brains has not yet been explored. In this project, organoids at different stages of development will be transplanted into rodent brains. The phenotype of transplanted tissue and the targets of its axonal projections will then be assessed. Participants in this project will learn principles of developmental and stem cell biology and a diverse set of skills, which may include growing and maintaining cerebral organoids, live animal surgeries, brain tissue processing, and immunohistochemistry. In addition to Dr. Chen, participants will work closely with Dennis Jgamadze (post-doctoral fellow) and James Lim (research technician).

Project 2: Improving the structure of human cerebral organoids

Cerebral organoids are 3D neural tissues that are derived from the self-organization of pluripotent stem cells. In important ways, they mimic the developing brain, including the formation of cerebral cortex layers. However, the growth of cerebral organoids also tends to be chaotic, with the generation of multiple progenitor zones and lobes of tissue. This situation makes it more difficult to use organoids as models for studying brain development and disease and as potential tissue for reconstructing brain circuits. The goal of this project is to identify factors that influence the number of progenitor zones that develop within a cerebral organoid. Specifically, this project will look at the impact of the initial number of stem cells used to generate the organoid. Participants in this project will learn principles of developmental and stem cell biology and a diverse set of skills, which may include cell culturing techniques, organoid tissue processing, immunohistochemistry, and fluorescence microscopy. In addition to Dr. Chen, participants will work closely with Dennis Jgamadze (post-doctoral fellow) and James Lim (research technician).

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OPHTHALMOLOGY

Jessica Morgan

Project 1: Investigating photoreceptor loss in retinal disease

The Morgan laboratory in the Department of Ophthalmology studies the human visual system using adaptive optics, a technology which permits visualization of individual light-sensing cells—rod and cone photoreceptors—in the living retina. With the ability to noninvasively observe the photoreceptor cells comes the ability to quantify parameters of the cell mosaic in the diseased retina in comparison to the normal retina. Students will work with data collected from normal and diseased retinas to measure and compare cone densities at several retinal eccentricities and quantify abnormalities in cone density in patients with known retinal pathology. The project will include compilation of a normative database of cone densities which also will be integrated into the human connectome project, and used to compare the variation in normal cone density with the variation in normal visual cortex collected by collaborators using from fMRI. During this project, the student will participate in state-of-the-art ophthalmic research, interact with normal control and diseased study participants, learn image processing techniques and retinal anatomy, and participate in all aspects of data collection, analysis and interpretation. In addition to lab work, students will attend weekly lab meetings giving them exposure to all ongoing projects in the lab. Motivated individuals with an interest in clinical research, pre-med, bioengineering, biology or neuroscience are encouraged to apply. Students must be highly organized, as this project will involve setting up and maintaining a database for retinal images and associated data. Prior experience with Photoshop and/or Matlab is preferred but not required.

Project 2: Probing vision at the cellular scale

The Morgan laboratory in the Department of Ophthalmology studies the human visual system using adaptive optics, a technology which permits visualization of individual light-sensing cells—rod and cone photoreceptors—in the living retina. Using the same technology, we can probe the limits of vision by presenting small light stimuli confined to single or small groups of cones and investigate visual system function both in normal sighted individuals and in patients with retinal disease. This summer project is part of an ongoing effort to incorporate these advanced visual function testing tools into our high-resolution adaptive optics ophthalmoscope. Two overarching goals of this ongoing project are (1) to link cellular-scale structure and function in patients with inherited retinal degeneration, and (2) to better understand how the retina and brain convey information about the world by studying the percepts elicited by stimulating individual neurons in the retina. The student will have the opportunity to participate in data collection and analysis and will be responsible for investigating how eye/pupil movement affects

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the delivery of the visual stimulus to the retina. During this project, the student will participate in state-of-the-art ophthalmic research, interact with research subjects, and learn optics and retinal anatomy. In addition to lab work, students will attend weekly lab meetings giving them exposure to all ongoing projects in the lab. Motivated individuals with an interest in bioengineering, clinical research, psychology, biology or neuroscience are encouraged to apply. Prior experience with using Matlab is preferred but not required.

Project 3: Developing metrics to assess photoreceptor structure in retinal disease

The Morgan laboratory in the Department of Ophthalmology studies the human visual system using adaptive optics, a technology which permits visualization of individual light-sensing cells—rod and cone photoreceptors—in the living retina. With the ability to noninvasively observe the photoreceptor cells comes the ability to quantify parameters of the cell mosaic in the diseased retina in comparison to the normal retina. To date, cone density is the metric most often used to describe the cone mosaic in these high-resolution adaptive optics images. However, our group has found that cone density on its own cannot fully characterize the abnormalities found in patients with inherited retinal degenerations. This summer project will be part of an ongoing research project writing software analysis tools that are aimed at investigating other metrics to characterize the living human eye at the cellular level, including analysis of the reflectance profiles of the individual cells. The student will have the opportunity to participate in data collection, software/analysis development, and application of analysis techniques to imaging data, comparing normal with diseased patient populations. During this project, the student will participate in state-of-the-art ophthalmic research, interact with research subjects, and learn image processing techniques and retinal anatomy. In addition to lab work, students will attend weekly lab meetings giving them exposure to all ongoing projects in the lab. Motivated individuals with an interest in bioengineering, image processing, or computer programing are encouraged to apply. Prior experience with using Matlab, C/C++/C#, or Java is preferred but not required.

Kenneth Shindler

Project 1: Resveratrol Neuroprotection in Optic Neuritis

Optic neuritis, an inflammatory optic nerve disease that occurs in multiple sclerosis patients, leads to some level of permanent visual loss in 60% of patients due to retinal nerve cell (RGC) damage. Identifying novel therapies that prevent RGC damage therefore has potential for preventing visual loss. We found that both intraocular injection and oral administration of the naturally occurring polyphenol compound resveratrol prevents RGC loss in mice with optic neuritis. Resveratrol is detectable in eyes after oral administration, but high doses are required to prevent RGC loss, raising concern for systemic side effects. Recently, we found that intranasal

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delivery of proteins leads to high concentrations accumulating in eyes and optic nerves; thus, this represents a novel drug delivery strategy to treat optic nerve disease.

The current project aims to examine whether intranasal delivery of resveratrol leads to significant accumulation of drug in the eye, and to determine optimal dosing to achieve similar levels as seen after oral drug administration. The student working on this project will learn all applicable methods, including how to work with laboratory mice, oral and intranasal drug administration, collection of tissue samples to measure drug levels, and data analysis. The student will work directly with the PI, Dr. Shindler, and will have assistance from a post-doctoral Research Associate, Dr. Reas Sulaimankutty, as well as a Research Associate, Ms. Kimberly Dine. Interested students must be willing to learn to work with mice, and take required University training courses (2-4 hours total) prior to starting this summer project.

Gui-shuang Ying

Project 1: Clinical Trials of Geographic Atrophy: Systemic Review of Registered Trials in ClinicalTrials.Gov

The ClinicalTrials.Gov trial registry launched more than a decade ago provides unique data on trial characteristics and results to the public. The data in ClinicalTrials.Gov has been widely used for a variety of clinical research. This project is to perform a systemic review of registered clinical trials for geographic atrophy (GA), an advanced manifestation of age-related macular degeneration (AMD). While GA accounting for ~20% of legal blindness in USA, there is no effective treatment for GA. In recent years, major pharmaceutical companies have sponsored increasing number of GA trials for various therapeutic agents. However, there are large variations in the design characteristics of GA trials. This systemic review will characterize the registered GA trials for their eligibility criteria, primary and secondary outcomes, sample size etc. Results from this review will provide useful insights to improve the design of future GA trials by using the standardizing the trial design parameters.

This project is particularly suitable for undergraduate students who have strong interest in clinical research or clinical trials, and have some basic skills in data collection and statistical analysis. The student will search the GA trials through ClinicalTrials.Gov using appropriate keywords, select the eligible trials, export the clinical trial data into excel sheet, perform some descriptive statistical analyses, and lead writing up the results for publication in an Ophthalmology journal. Student will undertake this work under the mentoring of an associate professor of Ophthalmology who has extensive experience in the trial design and conduct, and analysis of trial data for eye diseases.

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ORTHOPAEDIC SURGERY

X. Sherry Liu

Project 1: Effects of Lactation and Weaning on Maternal Bone

During lactation, increased calcium demand caused by milk production results in dramatic maternal bone loss. In fact, during the lactation period, bone is lost at an even faster rate than in osteoporosis. However, in contrast to osteoporosis, the rapid bone loss caused by lactation is quickly reversed, and bone mass is recovered following weaning. Our lab is interested in better understanding the mechanism that causes this dramatic recovery of bone mass. Using a rat model, we are working to assess the effects of lactation and post-weaning recovery on bone structure and mechanical function. This project will involve analysis of CT scans and histology slides of bone made at various time points during lactation and after weaning. Students will use image processing techniques to make precise measurements of bone structure, remodeling, and mechanical properties, in order to determine the effect of lactation and recovery on bone quality. Additionally, students will monitor the rats as they go through the process of mating, pregnancy, lactation and weaning, allowing students to gain valuable experience in animal research. This project would be ideal for an engineering student with interests in biomechanics, physiology, and imaging. Students will gain experience in image processing, experimental techniques, and data analysis. An interest in working with animals and a basic understanding of computer programming are helpful for this position.

Project 2: The structure-function relationship in bone due to osteoporosis treatments

As bone changes due to aging and hormones, the normal robust pattern of trabecular bone is degraded by the loss and breakage of existing trabecular elements. This degraded bone often results in osteoporosis and serious fractures in the elderly. Drug treatments must be developed to optimize the restoration of bone while minimizing excessive bone gain. This project will aim to better understand the structure-function relationship of human trabecular bone on an individual trabecular level. Students will use a series of three-dimensional images from high resolution quantitative computed tomography (HRpQCT) scans of patients with osteoporosis. By aligning the trabecular patterns in these scans before and after treatment using computer optimization, they will identify precise changes to the structure over time, and quantify each change's contribution to the bone's mechanical function. Mechanical function will be assessed using finite element analysis. The student will have the opportunity to work with clinical bone images and cutting edge computational methods. This project would be ideal for bioengineering students or those in computer science with an interest in biomedical sciences. This student must be very comfortable working with computers, as they will be expected to eventually do computer

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optimizations and simulations independently. No experience is required, but skills in computer programming would be helpful.

Louis Soslowsky

Project 1: Orthopaedic Bioengineering

The overall goals of our research program are to determine fundamental relationships and mechanisms of tendon and ligament injury, healing, repair, and regeneration and to use this information to develop and evaluate potential treatment modalities. Undergraduate researchers are important to our research program as we have mentored many over the years. Students can expect to work with graduate students and postdocs on mechanical testing, histology, animal surgery, and other experiments. Ideally, students will continue on with us following the PURM project to gain additional experience and mentorship.

OTORHINOLARYNGOLOGY

Yale Cohen

Project 1: Auditory Computational Neuroscience

Duties/responsibilities. This project entails examination of the population dynamics of auditory perception and decision-making. The student will analyze large-scale neuronal databases and test specific computational hypotheses about how the brain encodes and represents auditory perception and decision-making. The student will also have the opportunity to observe electrophysiological recordings. The student will analyze the data, prepare figures that summarize their analyses, and present the data to Dr. Cohen and the members of the post-doctoral mentoring team (Drs. Francisco Campos, Jaejin Lee, and Taku Banno). Specific analyses include [but are not limited] to (1) the contribution of correlated noise to perception; (2) population coding of stimulus invariance; (3) dynamics and computations between cortical layers.

Prerequisities: Experience programming in Matlab is mandatory. Ability to work independently and a part of a group.

The student will work in conjunction with Dr. Cohen and post-doctoral fellows in the laboratory

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PATHOLOGY

Robert B. Faryabi

Project 1: Precision medicine for cancer with next-generation sequencing

The ability to identify genetic alterations in cancer tumors using next-generation sequencing (NGS) has dramatically altered the healthcare landscape. These technological advances have shifted the focus from "average patient"-based treatment to delivery of personalized therapy guided by mutations in the patient genome. However, the genome-based cancer therapeutic matching is limited by incomplete understanding of the combinatorial pattern of mutation events, and their correlation with prognostic outcomes. The occurrence of two mutation events together is the most basic form of combinatorial mutations events. The goal of this project is to map the patterns of mutation co-occurrences across different tumor types, and find their correlation with prognostic outcomes.

A successful applicant will implement a statistical method developed in the lab for assessing the significance of mutation co-occurrence, and will use Cytoscape.js to visualize this information in an interactive graph abstraction. She/he will apply the method to the research data generated by The Cancer Genome Atlas (TCGA) and International Cancer Genome Consortium (ICGC) consortia, as well as the clinical NGS data collected at the Center for Personalized Diagnostics (CPD) at PENN. The objective is to identify statistically significant instances of clinically important mutation co-occurrence in thousands of clinical samples at CPD, and assess their presence in research setting where more limited sample size. The student(s) will submit an abstract to MidAtlantic Bioinformatics meeting held by PENN/CHOP and will present upon acceptance. If significant progress is made, an article will be submitted for publication to Association of Molecular Pathology journal. Programming (Java/Python), and Linux command-line experience will be necessary for successful progress.

Daniel Powell

Project 1: Cancer Immunotherapy

PURM student candidate will be partnered with a graduate student and/or postdoctoral researcher to understand the interplay between the immune system and cancer cells and to develop immunotherapeutic strategies that permit or enhance anti-tumor immune responses in vitro and in preclinical cancer models.

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PEDIATRICS

Charles Bailey

Project 1: Measuring Quality of Children's Health Care

Prevention of illness and support of normal growth play a central role in pediatric care. Being able to reliably measure quality of this care is an important prerequisite to testing potential improvements, as well as examining the adoption of new knowledge into practice. As electronic health records become more widely used, it is becoming possible to automate measures in large populations of patients, rather than small samples, and get a clearer picture of the quality of care. This project is examining how well three known quality measures – testing for risk of stroke in children with sickle cell disease, choosing the right antibiotic when treating ear infections, and screening for cholesterol/lipid side effects of psychoactive medications – perform in a large network of hospitals that has adopted a common set of data standards. Working with pediatricians (Dr. Bailey, Dr. Levon Utidjian) and data scientists, the student will participate in computation of measures, validation of computed results through review of medical records, and comparison of results across different hospitals and groups of children. The work will help one become familiar with the process of quality measurement, the advantages and disadvantages of using large datasets to learn about populations, and the potential of quality measures to inform institutional decisions about quality improvement. Prior experience with databases or basic statistics is welcome, but not a requirement. The ability to organize numbers and work as part of a collaborative team is a must. This project might be especially interesting to students interested in pediatrics, health policy, or what "big data" means in a health service context.

Project 2: Supporting children during cancer treatment

Cancer is a rare disease in children, and the great advances seen in pediatric cancer therapy over the past forty years have been the result of very large collaborative studies in consortia such as the Children's Oncology Group. These studies have focused on finding curative therapy while managing the many potential side effects of current medications. Supportive care, the parts of treatment that reduce these adverse effects, has been studied in more limited contexts. We are using both institutional data from CHOP, and data from PEDSnet, which includes seven other children's hospitals, to better understand the impact of side effects such as malnutrition and infection on progress of cancer treatment, and to evaluate ways to reduce this burden. The student will work with pediatric oncologists (Dr. Bailey, Dr. Charles Phillips) and clinical informaticians to develop automated methods, called computable phenotypes, for characterizing cancer therapy in large hospital datasets. Using these algorithms, we assemble groups of children and follow their path through treatment to evaluate the risks of side effects and the degree to which different interventions, such as early nutritional supplementation, can lessen

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these burdens. Work will involve validating phenotype algorithms in data and medical records, and scoring clinical data for outcomes of interest. Database programming or medical skills are not required; our goal over the summer will be to teach students the basics of data management and observational methods, as well as a critical eye for strengths and weaknesses of data. Students considering a career in medicine or a related field of health may find this work especially interesting, as well as anyone with an interest in childhood cancer therapy, secondary use of data (that is, using data that were collected as part of regular clinical care to learn more about how well that care works), or learning health systems.

Lamia Barakat

Project 1: Economic Evaluation of Long-term Survivors of Childhood Cancer treated on Clinical Trials

Approximately 21,000 children under 20 are diagnosed with cancer each year in the U.S. Improvements in medical care continue to decrease the mortality rate for all childhood cancers, and 80% of children diagnosed with cancer will survive. Cancer, however, remains the leading cause of disease-related death for children, with the survival rate varying by type of cancer and age at diagnosis, and two-thirds of children who survive cancer live with significant sequelae of the cancer and/or treatment. Clinical trials for childhood cancer have the goal of testing new approaches to increasing survival while decreasing toxicities of treatment. More than 60% of children with cancer under age 15 years receive treatment through a therapeutic clinical trial compared with 5% of those older than 20 years. The differential enrollment by age has been linked to the higher mortality and morbidity for AYA with cancer compared to their younger counterparts. Understanding the long-term costs and quality of life outcomes of treatment associated with clinical trial participation is critical to both justify the societal costs of and inform decision making for children and families considering participation in a cancer clinical trial. This study evaluates the economic impact of clinical trial participation by conducting an economic evaluation that describes survival, costs and health related quality of life. Utilizing the Children's' Hospital of Philadelphia (CHOP) clinical trial and tumor registry and CHOP's electronic health record system (EPIC), the PURM student will assist with conducting chart reviews to identify patients' trial status and long term effects of cancer and/or treatment (i.e. comorbidities, relapse). Additionally, the PURM student will assist with recruitment, consent and facilitation of surveys for survivors of childhood cancer or their caregivers. The PURM student will also participate in biweekly research meetings related to this project and will be encouraged to attend other Behavioral Oncology Program research meetings and lectures and seminars at the CHOP Cancer Center to gain a better understanding of research processes and disciplines. In addition to Dr. Barakat, the PURM student will be supervised by Dr. Marilyn Schapira (Abramson Cancer Center) and Evelyn Stevens, MPH (Clinical Research Coordinator).

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Chris Bonafide

Project 1: Smartphone baby monitor accuracy testing

A new market of high-tech baby monitors that measure heart rate, blood oxygen levels, and breathing rate has emerged. These devices are innovative and appealing to parents, but have not been approved by the FDA. As a result, we know very little about their safety or accuracy. This project will involve the student interacting with parents and infants who are hospitalized, connecting baby monitors to them, video recording the baby monitor and a hospital monitoring device, downloading and later reviewing the video to assess the accuracy of the consumer monitor compared to the hospital monitor. For details on these products, check out this video describing these products:

https://www.youtube.com/watch?v=kC903Re9AgE

Prerequisites: ability to troubleshoot challenging technology, experience editing video, and experience working with infants in some capacity.

Elizabeth Foglia

Project 1: Eye Tracking during Delivery Room Resuscitation

Up to 10% of infants require resuscitation immediately after birth. Neonatal resuscitation is a dynamic and high-stakes process, and clinicians must quickly integrate all available information from the patient, team, and monitoring equipment. We are investigating methods to facilitate rapid and correct assimilation and interpretation of physiologic data from patient monitors during resuscitation.

In this project, we use cutting-edge mobile eye tracking glasses to characterize the attention and gaze behavior of neonatal practitioners during delivery room resuscitation. The eye tracking glasses provide a mechanism to identify and quantify the exact focus of visual attention for providers performing neonatal resuscitation. Using this technology, we can identify key areas of visual focus, with the ultimate goal of improving the landscape and efficiency of the neonatal resuscitation.

The study team is looking for a motivated and independent student who will be responsible for processing and cleaning the eye tracking data. Previous experience using eye tracking software is not necessary.

The skills and experiences gained while working on this project include: develop a proficiency in the novel technique of eye tracking capture, mapping, and analysis, collaborate with study team, and attend live neonatal resuscitations.

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This student will learn about the medical conditions that lead to neonatal resuscitation, gain exposure to project development and processes, and can attend internal scientific and clinical conferences for the Division of Neonatology at CHOP and HUP. There will be opportunities to support other Neonatal research projects, with duties including patient chart review, resuscitation video review, and statistical analysis.

Elizabeth Lowenthal

Project 1: Increasing HIV Testing of Vulnerable Children and Adolescents in Zimbabwe

HIV is currently the leading cause of death for 10-14 year olds worldwide. This is mainly due to late diagnosis of infections that were acquired at the time of birth. This project aims to decrease the stigma surrounding HIV testing and to increase HIV testing of children and adolescents in high-prevalence settings. The student involved in this project will be based in Philadelphia and will work with de-identified data from the Zimbabwe-based study. The ideal student for this project is detail-oriented team player who is passionate about working to improving child health in resource-limited settings. The student will learn to work with large amounts of data using professional databases and statistical analysis software. The student's roles may include assisting with data-cleaning, performing basic statistical analyses, coding English translations of qualitative research data, and assisting with creating materials that will help with making the intervention useful in other settings in the future. The student will be involved with regularly scheduled international conference calls with Zimbabwe-based team members. There are no prerequisite skills required. In addition to Dr. Lowenthal, students will work closely with her research coordinator, Jennifer Chapman, MPH. Ms. Chapman is also an experienced international researcher.

Project 2: "A Fish in Every Pot"

This project is using a novel intervention for iron-deficiency among children in the Dominican Republic. A fish-shaped piece of iron is given to families to boil while preparing their food in order to iron-fortify the food. We are investigating whether the routine use of this "iron fish" is acceptable to families in a community with a high prevalence of childhood iron-deficiency anemia and whether relevant biomarkers improve among children whose families use the fish. The student involved in this project will be based in Philadelphia and will help with data cleaning and analysis for the iron fish project. The student will learn to use a REDCap database and STATA statistical software. In addition to working with Dr. Lowenthal, the student will work remotely with Dr. Ryan Close who initiated the project and assists with its supervision. There are no prerequisites for this project.

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John Maris

Project 1: Translational pediatric cancer reserach

The Maris laboratory focuses on the childhood cancer neuroblastoma, and has projects spanning basic discovery using advanced genomics to clinical trials. There are available projects across this spectrum, including discovery of genetic driver lesions, validation of discoveries, developing drugs against potential therapeutic targets running preclinical trials, and assisting with clinical trials.

Lisa Schwartz

Project 1: Using Mobile Devices to Track Physical Activity of Adolescent and Young Adult (AYA) Survivors of Childhood Cancer

Seventy percent of childhood cancer survivors develop second cancers or late effects from treatment that can impact any organ system. Research has suggested that these effects may be mitigated by health promoting behaviors such as moderate to vigorous physical activity (MVPA). However, AYA survivors tend to be more sedentary than peers. Our research team, comprised of UPenn and CHOP faculty, recently received funding to study MVPA in adolescent and young adult cancer survivors (AYA). This exciting study will leverage new mobile sensor technology and ecological momentary assessment to record MVPA in AYA to increase our understanding of MVPA in childhood cancer survivors. The specific aims of the study at CHOP are to test the feasibility and acceptability of using wearable devices in this AYA population, as well as to test reciprocal determinants of MVPA using real time measurements. We will work closely with Penn's mhealth core to execute the study. The student chosen to work with our team will gain experience in mobile health and AYA survivors, as well as working with a multidisciplinary team comprised of a psychologist, cardiologist, oncologist, and technology experts. The student may specifically assist with recruitment, which would involve having the AYA complete self-report measures and setting up devices, monitoring the input of data from wearable devices, and collecting devices back from AYA. The student would be part of an exciting pilot study that we expect will inform future interventions.

Project 2: Testing a Mobile Health App to Improve Survivorship Self-Management of Adolescent and Young Adult Survivors of Childhood Cancer

Over 80% of children diagnosed with cancer become long-term survivors. Unfortunately, cure is not without consequence; and 70% develop second cancers or chronic or life threatening late effects from their treatment during young adulthood. Detailed guidelines recommend follow-up care to manage and monitor for late effects and recurrent or new cancer. Survivors are also

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expected to “get back to normal”, engage in health promoting behaviors, and get follow-up tests. These self-management tasks are often difficult for adolescent and young adult (AYA) survivors. To improve AYA survivor health and engagement with important follow-up care, we are testing a CDC-funded randomized controlled trial that is delivering a technology-based intervention to AYA survivors. AYA survivors will all receive a survivorship care plan and then will be randomized to receive (or not receive) a mobile health application that delivers tailored text messages to enhance uptake of the participant’s survivorship care. This study will take place mostly at CHOP, with some patient recruitment at Penn, as well. The study team is large and includes behavioral scientists and physicians. The student on this project will gain valuable experience with AYA survivors, mobile health, and randomized controlled trials. The student will specifically help with AYA recruitment, which includes completing self-report measures and setting up the app, monitoring engagement with the app from the back end, and engaging AYA in follow-up measures. The student may also help with medical chart reviews.

PHARMACOLOGY

Elizabeth Heller

Project 1: Epigenetic editing of Cdk5 in stress ***Rising Sophomore only***

Chronic stress exacts an enormous toll on the global population. Over the past several decades it has become clear that changes in gene expression likely underlie this disorder and may be conferred by molecular alterations to the genome, known as epigenetic modifications, rather than gene mutations. This proposal takes advantage of recent advances in epigenome editing technology to manipulate one particular gene implicated in depression, Cdk5. This gene has been shown to underlie stress responsiveness in various brain regions in rodent models of depression. This project aims to examine the role of Cdk5 in the context of chronic unpredictable or variable stress in mice, a behavioral model that mimics that chronic nature of stress and has been used as a correlate of stress-related pathophysiology in both male and female mice.

Students researchers will be included in all aspects of this project, including mouse handling and stress exposure, brain dissections, tissue processing and stereotaxic surgical procedures. Training in laboratory safety and animal handling is required and will be provided through KnowledgeLink and ULAR. Students will work directly with the lead postdoctoral fellow of this project, Dr. Ajinkya Sase, as well as receive training and guidance from Dr. Heller. Students will participate in all aspects of the lab, including lab meetings and social outings.

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Project 2: Epigenetic editing of Cdk5 in learning and memory.

Regulation of the cell signaling molecule, Cdk5, has been implicated in learning and memory. Most studies to date have focused on the regulation of Cdk5 protein, with little data on the mechanisms of transcriptional regulation at this locus. This proposal takes advantage of recent advances in epigenome editing technology to manipulate histone modifications at the Cdk5 locus. This project aims to examine the role of Cdk5 in the context of spatial memory in mice, with a focus on the precise temporal and spatial regulation of this gene in vivo following learning. Students researchers will be included in all aspects of this project, including mouse handling and fear conditioning exposure, brain dissections, tissue processing and stereotaxic surgical procedures. Training in laboratory safety and animal handling is required and will be provided through KnowledgeLink and ULAR. Students will work directly with the lead postdoctoral fellow of this project, Dr. Ajinkya Sase, as well as receive training and guidance from Dr. Heller. Students will participate in all aspects of the lab, including lab meetings and social outings.

Steven Thomas

Project 1: Novel molecular mechanisms in the establishment of memory

The lab utilizes genetic, pharmacologic and biochemical approaches in mice to unravel the molecular mechanisms that underlie learning and memory. Recently we discovered a novel signaling mechanism that dissociates the formation of short-and long-term memory. We are currently trying to understand where in the brain and in what cells this signaling acts to facilitate memory formation. To achieve this, we have flanked the gene for the relevant receptor with loxP sites that permit cell type - and brain region-specific deletion of the receptor. We also have an antagonist that is highly selective for this receptor that can be infused into specific brain regions. We would also like to determine the nature of the downstream signaling mechanisms activated by this receptor that are relevant to memory formation. Toward that goal, pharmacologic rescue of memory will be performed in receptor knockout mice. The student is to perform tests of memory using wild-type and mutant mice, and combine these with pharmacologic manipulations. In addition or instead, the student will perform highly sensitive in situ RNA assays on brain sections to assess the cell-specific loss of receptor expression in wild-type and mutant mice. The professor and a full-time research specialist will provide training.

Project 2: Neurotransmitter signaling in health and disease

The adrenergic nervous system is an arousal system that contributes to the "fight or flight" response. In the periphery this is mediated by the release of norepinephrine from the sympathetic nervous system and epinephrine from the adrenal gland. In the brain, this is mediated by the release of norepinephrine from the brainstem adrenergic nuclei. To better understand the

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physiologic roles of this system in health and disease, the lab has recently created a genetic system in mice that permits the inducible loss of norepinephrine and epinephrine. This mimics some disease states in which the adrenergic neurons degenerate, including Alzheimer's, Parkinson's and Down syndrome. To better understand what symptoms may underlie the loss of adrenergic signaling, the lab is poised to study this novel genetic model. Because one focus of the lab has been to better understand the molecular mechanisms that underlie learning and memory, one set of experiments will be to utilize these mice in behavioral studies that assess learning and memory. Various paradigms will be used to assess different types of learning and memory, including declarative memory, implicit memory, and motor learning. The student is to perform tests of memory using wild-type and mutant mice, and combine these with pharmacologic manipulations. The professor and a full-time research specialist will provide training.

PHYSIOLOGY

Joseph Baur

Project 1: CRISPR Modification of Primary Hepatocytes

Primary hepatocytes are a useful culture system in which to study certain aspects of liver metabolism that are not adequately modeled by hepatoma cell lines, including glucose production. However, hepatocyte lifespan under standard growth conditions is only about 48 hours, which does not allow sufficient time for genetic modification. Using optimized media and growth factor conditions, we can now maintain viability and glucose production for up to 8 days. We seek a summer student to help develop efficient methods for CRISPR-based modification of primary hepatocytes within this 8-day lifespan. This technique will have wide-ranging applications, but will initially be used to test the mechanisms required for metformin action. Metformin is a front-line antidiabetic drug that suppresses hepatic glucose output, but there is ongoing controversy over the downstream pathways that mediate its effects. The ability to knock out individual components of these pathways in hepatocytes would help to resolve this question. The selected student will gain experience in mammalian cell culture, use of viral vectors, and biochemical assays, and will have the opportunity to work with live mice and observe surgical procedures.

Project 2: Role of mTORC2 Signaling in Hypothalamic Neurons

Obesity is fundamentally caused by an imbalance between energy intake and energy expenditure. Although voluntary exercise and dieting can temporarily correct or reverse this energy imbalance, there is a growing recognition that the body will adjust behaviors to attempt to return

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to the obese “set point” and that very few people are able to achieve stable long-term weight loss. Some promise has been shown for drugs that inhibit nutrient absorption or suppress appetite, but comparatively little is known about the control of basal activity levels. We have recently shown that mice lacking Rictor, an essential component of the mTORC2 kinase, in hypothalamic neurons become obese despite normal food intake. Instead, energy imbalance appears to be the result of a ~50% decrease in spontaneous locomotor activity. We seek to understand which signaling pathways are responsible for mTORC2 activation in hypothalamic neurons. mTORC2 activity will be examined in the hypothalamus after treatment with hormones including insulin, leptin, and ghrelin, as well as during fasting/feeding transitions. Separately, we will test which subsets of hypothalamic neurons are responsible for the obese/lazy phenotype using more selective Cre drivers (Project 3, below).

Project 3: Determine Which Subset of Hypothalamic Neurons Influences Locomotor Activity in an mTORC2-Dependent Manner

The mice described in project 2 above lack mTORC2 activity in most hypothalamic neurons, and also in some cells of the thyroid and lungs. To determine whether the obese/lazy phenotype is due to specific subpopulations of hypothalamic neurons, we are deleting this complex using more specific Cre drivers, beginning with Agrp and Pomc. These mice will be available before the summer, and we seek a student researcher to assist in their phenotyping. This will include determination of body weight, fat mass, food intake, and activity levels. Understanding the neuronal population responsible for decreased locomotor activity will facilitate interventions to create the opposite phenotype: mice with high spontaneous activity that we speculate will be protected from obesity. This project will provide hands-on experience with mice, as well as opportunities to learn RT-PCR, western blotting, and histology.

PSYCHIATRY

Anu Asnaani

Project 1: Measuring Improvement in OCD Patients Receiving Exposure Therapy ***Rising Junior only***

Cognitive Bias Modification (CBM) refers to an experimental paradigm that aims to change unhealthy cognitive patterns. In this project, we examine the impact of such modification on individuals with OCD. The goals of this ongoing study are threefold: 1) to examine the effectiveness of possible adjunctive interventions like CBM for individuals receiving standard treatment for OCD; 2) to examine whether such modification of negative thinking bias is already impacted by treatment of OCD itself, and whether this is different among different types of

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anxiety disorders; and 3) to examine whether it would be useful to implement CBM in anxiety disorders aside from OCD. Volunteers for this project will be supervised by Anu Asnaani, Ph.D., and Lily Brown, Ph.D., in the administration of experimental paradigms in patients with OCD and other anxiety disorders. Participants will be trained in the collection and analysis of physiological, self-report, and behavioral indices of response to CBM. In addition, volunteers will receive seminars lead by Dr. Asnaani on the theory and practice of effective behavioral treatments for OCD, PTSD, and other anxiety disorders. There will be plentiful data for the PURM student to develop and examine their own question of interest for a poster at the end of the PURM period under significant mentorship of Drs. Asnaani and Brown.

Project 2: Testing the feasibility and utility of a mobile application "PE Consultant" in improving supervision resources for providers trained in treatments for PTSD ***Rising Junior only***

This project is a qualitative, non-randomized pilot study examining the utilization and helpfulness of a mobile training tool to help providers trained in Prolonged Exposure for PTSD feel more competent and comfortable using this highly effective treatment for PTSD in their individual community settings. The study provides free access to the mobile training tool to participating providers for a 6 month period, with periodic questionnaires (using REDCap) and qualitative feedback interviews (via phone) at 1 month, 3 months, and 6 months after the participant is given access to the application. The PURM student involved in this study will be part of recruitment efforts of community therapists into the study, will learn how to give feedback, reminders and technological assistance in using the mobile app, will be involved in the data analysis of outcomes from using the app, and will also be involved in the preparation of larger grant applications based on this study's initial data. The application has already been developed and the study has been approved by the IRB; the PURM student will be encouraged to analyze and present some portion of the study results (qualitative or quantitative) at the end of the PURM session in poster format. Study investigators Dr. Anu Asnaani and Dr. Laurie Zandberg would provide mentorship and guidance throughout the PURM experience.

Project 3: Reliability and Validity of Brief Tablet Game Screening for PTSD in Children ***Rising Junior only***

The purpose of this study is to examine how reliable and easy to use a tablet game that helps clinicians assess for PTSD symptoms is in detecting PTSD in children aged 8-12 years. The tablet game is designed using an interactive and animated game format to help make it less distressing to screen for PTSD in children. The research team goes into a primary care clinic in South Philadelphia to meet with potential child participants and their families, consenting them to the study if eligible/interested, and then administering the game with some paper and pencil forms, and handling scheduling of a second visit for re-administration of the game if applicable. The PURM volunteer would accompany the study RA to the site, learn how to consent and collect data from child participants, learn how to manage the data upon return to our clinic, data

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analysis of such measurements, and would end in producing a poster based on some aspect of the data or study process that is most interesting to the student. The student would also receive education about how prolonged exposure for PTSD works for children, adolescents and adults over the course of their PURM experience, and be mentored by Dr. Anu Asnaani for their individual research project.

Rinad Beidas

Project 1: The Philadelphia Alliance for Child Trauma Services II (PACTS II): Reaching the Most Vulnerable Youth

Traumatic stress in children and adolescents arises from many different experiences (e.g., neighborhood violence; physical, emotional, and sexual abuse; natural disasters) and has varied effects on the individuals it impacts. The Philadelphia Alliance for Child Trauma Services (PACTS) is a system-wide trauma universal screening, education, prevention, and intervention program throughout the city. For the past four years, Dr. Beidas' team at the Center for Mental Health Policy and Services Research (CMHPSR) has investigated the effectiveness of providing trauma-focused cognitive-behavioral therapy (TF-CBT) in community mental health centers and has completed evaluations of 113 clients. Over the course of the next five years, Dr. Beidas' team will begin the second phase of this project with a special focus on groups particularly vulnerable to trauma: lesbian, gay, bisexual, transgender, and questioning (LGBTQ) children and commercially sexually exploited children. Findings from this research have and will continue to inform both City-wide and national roll-outs of trauma-informed care and provide information on whether the implementation of this evidence-based practice improves youth outcomes in the community.

Interested undergraduates will have the opportunity to work on a complex, multifaceted study by assisting with tasks like preparing folders and entering data from completed evaluations. There also may be opportunities for RAs to assist the team with scheduling appointments with families and therapists, transcribing and coding qualitative data from semi-structured interviews, and attending PACTS-related meetings with key public health stakeholders at Community Behavioral Health. Students will receive mentorship from Dr. Rinad Beidas, who has experience mentoring previous PURM students.

Project 2: Fidelity Accuracy: Comparing Three Strategies (FACTS)

What do therapists in community mental health agencies do in sessions with their youth clients? How can we measure the extent to which therapists deliver cognitive behavioral therapy (CBT), an evidence-based practice, as it is intended to be delivered – in other words, how do we measure fidelity? Project FACTS looks to answer these questions by studying three different methods used to measure therapist fidelity to CBT and assessing which is the most accurate and cost

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effective. Successful completion of this project will identify accurate fidelity measurement methods as well as factors that can increase their uptake in community mental health settings. This multifaceted study provides those working on it opportunities to learn about a number of topics with cross-cutting relevance, like implementation science, cost effectiveness, community-academic partnerships, and approaching complex topics like therapist-client interaction with both sensitivity and scientific rigor.

The undergraduate research assistant work within a dynamic, collaborative research lab and help to prepare for agency visits and process data. They may also have the opportunity to accompany researchers on visits to community mental health centers—a rare and valuable experience for undergraduate students. Students will receive mentorship from Dr. Rinad Beidas, who has experience mentoring previous PURM students.

Project 3: Adolescent Suicide Prevention In Routine clinical Encounters (ASPIRE)

How can we prevent youth suicide? Data indicate that, in the year preceding a suicide attempt, only one in three youth visited a behavioral health provider, but four out of five visited a primary care provider—which suggests that primary care may be an appropriate setting for a universal intervention strategy. In particular, the promotion of safe firearm practices (firearms means restriction) is a promising but infrequently used suicide prevention strategy in the United States. Despite the existence of an evidence-based intervention to address this problem (Safety Check), pediatric primary care providers rarely discuss means restriction during visits, suggesting the need for a better understanding of barriers and facilitators to implementation. In 2016, Dr. Beidas' team completed surveys of leadership and physicians in 96 pediatric primary care practices to understand the acceptability and use of Safety Check's three components. This year, we will conduct qualitative interviews with stakeholder groups (e.g., parent-youth dyads, leaders of behavioral health) to develop implementation strategies for youth firearm safety in pediatric primary care. The long-term goal of this research is to reduce death by suicide by increasing the use of evidence-based strategies in pediatric primary care while promoting multi-level implementation strategies.

Undergraduate applicants will participate in research on a pressing public health issue in a mixed-methods research lab. Day-to-day work will include transcribing qualitative interviews mentioned above. This project is well-suited for those interested in healthcare, policy, psychology, and psychiatry. Students will receive mentorship from Dr. Rinad Beidas, who has experience mentoring previous PURM students.

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Edward Brodkin

Project 1: Developing an assay of excessive selfishness

The student will be involved in a project to develop a behavioral assay of excessive selfishness in mice, that will be used for neurobiological and genetic studies of this behavior. The students duties /responsibilities will include using video analysis of mouse behaviors, data entry, data graphing, and statistical analysis. Prerequisites include some coursework in cognitive psychology or behavioral neuroscience. Some experience in analyzing mouse behaviors is preferred. Students will gain additional experience in detailed behavioral analysis and data analysis. This would be a good position for students interested in psychology or behavioral neuroscience.

Project 2: The role of the Neurexin1in autism spectrum disorder ***Rising Sophomore only***

We are conducting a large human genetics study of autism spectrum disorder (ASD) / Aspergers disorder, focused on the role of the Neurexin1 gene in ASD. We are recruiting human participants with various types of deletions of neurexin1, as well as their extended family members, and using a family-based genetics approach to study the effects of neurexin1 deletions on behavioral phenotypes relevant to ASD. We are also using whole genome sequencing of participants and their family members to search for other genes that may interact with neurexin1 to affect behavioral phenotypes relevant to ASD. A student working on this project would assist with recruitment, phenotyping (measurement of ASD behavioral traits), and genetic analysis. Some background in psychology, neuroscience, genetics, or the biological basis of behavior is preferable, but not required.

Lily Brown

Project 1: Physiological Responding in the Treatment for Posttraumatic Stress Disorder

Posttraumatic stress disorder (PTSD) is a fear-based disorder following exposure to a trauma that causes significant distress and impairment. Prolonged Exposure is a gold standard treatment for PTSD that is associated with significant reductions in PTSD symptoms, and functional impairment. Little is known about how physiological responding is altered by treatment. As part of Project 1, undergraduate volunteers will be trained by Lily Brown, Ph.D., in the extraction, analysis, and interpretation of physiological responses to a randomized controlled trial of PE. The larger trial, conducted by Edna Foa, Ph.D., the developer of PE and director of the Center for the Treatment and Study of Anxiety, is comparing standard administration of PE to a briefer version of PE, the goal of which is to determine whether this variant on the therapy is equally as effective. As part of this trial, research participants provide weekly measures of physiological

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responses to therapy procedures. Undergraduate volunteers will learn about two key markers of physiological responding, namely skin conductance response and heart rate. In addition, volunteers will participate in seminars about the theoretical background on these measures, their measurement in clinical and experimental psychology, and about debates in the field regarding the most accurate assessment of physiology in anxiety and mood disorders, including PTSD. Volunteers will be trained in physiological preprocessing and analysis using software commonly used in the field. They will also be trained in consolidating analyses for use in addressing key research questions.

Project 2: Fear Extinction in Obsessive Compulsive Disorder

Obsessive compulsive disorder (OCD) is characterized by excessive anxiety about feared thoughts, images or impulses, coupled with compulsions, or rituals used to reduce fear and anxiety. Exposure and response prevention (ExRP) is an empirically-supported treatment that significantly reduces distress and anxiety in OCD, yet may patients who complete ExRP experience a return of fear sometime thereafter. The goal of Project 2 is to design and implement an experimental study focused on measuring fear conditioning, extinction, and return of fear in OCD. In addition, Project 2 is focused on measuring varying intensities of fear conditioning to determine the effect on fear sensitization, or heightened responding to new stimuli. As part of Project 2, undergraduate volunteers will be trained in the design and implementation of the trial. Volunteers will learn how to program computer software to allow for appropriate stimulus delivery and measurement of responses to those stimuli. They will also learn about measuring physiological, subjective, and behavioral responses during experimental studies of clinical psychopathology. In conjunction with Project 1, Project 2 will involve training volunteers on the collection, extraction, and analysis of physiological responses. Volunteers will receive training in conducting an experimental trial in patients with OCD through the CTSA. They will complete seminars on OCD and related anxiety disorders to learn about the etiology, maintenance, and treatment of these disorders under the guidance of Drs. Lily Brown, Anu Asnaani, and Laurie Zandberg.

C. Neill Epperson

Project 1: Early Life Stress Impact on Behavioral Health, Stress Response and Inflammation Across the Lifespan

Early life stress (ELS) leads to numerous adverse health outcomes. How ELS "gets under the skin" to impact health and wellbeing in humans is not known. The enduring impact of ELS on hypothalamic pituitary adrenal and inflammatory response to current life stressors is a likely contributor. The Penn Center for Women's Behavioral Wellness and Penn PROMOTES Research on Sex and Gender in Health hosts a summer intern program for up to 4 students. Students who wish to participate are required to complete a brief on-line application. Any

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student referred by CURF for the PURM program will not need to complete this application, but will be expected to meet the Center Director (Epperson) and other principal investigators and research/administrative staff. The summer research fellowship includes participation in several research projects, didactics, research meeting and journal club. Students who participate will become proficient in their understanding of 1) psychoneuroendocrinology, 2) study methods to examine the impact of stress and gonadal steroids on behavior, psychophysiology and brain structure and function, 3) participant recruitment methods, informed consent process and participant assessments and 4) how to become an integral part of a highly productive research team. No prerequisites are required. However, successful students will have a strong interest in human research in general and in the areas of women's behavioral health, psychoneuroendocrinology and sex differences in specific.

Matthew Hayes

Project 1: Neuroendocrine control of energy balance

This laboratory and animal model based research is centered on discovering how the brain integrates signals of energy balance and ingestive behavior which contribute to starvation (i.e., lack of hunger). The student will engage in behavioral neuroscience research from the single cell to the whole organism. The work will be performed in a small laboratory setting with direct mentorship by senior students/lab members and the Principal Investigator as part of a behavioral nutritional nutrition team. No undergraduate research experience is necessary, however a strong interest in nutrition/energy balance is preferred. The student will benefit from a setting where all lab members are encouraged to participate in all aspects of research. The student will also engage in scholarship and participate in regular lab meeting to understanding the field and nature of the research beyond the experiments at hand.

Michael Perlis

Project 1: Prospective Assessment of the Etiology of Insomnia in Middle Aged and Elder Adults

The purpose of this study is to learn more about how often insomnia is experienced by adults in the general population (focusing on those that are middle age or older). The study team is investigating how often insomnia occurs and what might cause acute (short-term) insomnia to develop into chronic (long-term) insomnia within these age groups. A small group of subjects from the larger study will be asked to complete two in-lab visits, once within a week or two of experiencing problems falling and/or staying asleep and again approximately 3 months later. During both lab visits, participants will complete two sleep studies and a series of computer

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based tests of executive function, attention and memory, and some questionnaires. Also during the course of the lab visits, a number of stress-related biomarkers (e.g., cortisol, alpha-amylase, norepinephrine) will be sampled via blood, urine, and saliva. Students will be primarily responsible for assisting with the in-lab portion of the study. Specifically, they will assist with study implementation and data collection. Students may also have opportunities to receive specific training in polysomnography, behavioral sleep medicine/treatments for insomnia, and correlates of sleep (e.g., aging, stress physiology). Professional development (i.e., grad school prep) opportunities will also be available to students. Students with a particular interest in sleep research or behavioral medicine are particularly encouraged to apply. Ivan Vargas, PhD, postdoctoral fellow in UPenn's Center for Sleep and Circadian Neurobiology, will also be involved in the mentoring components of this program.

Project 2: Natural History of Sleep Disturbance in Childbearing Women: A Feasibility Study

Sleep disturbance among new mothers is ubiquitous and presents a profound challenge, not only to mothers' health and well-being, but also to that of their infant. The present study is designed to 1) evaluate pregnant and non-pregnant women for differences with respect to cumulative sleep disorder morbidity, and determine which specific sleep disorders account for these differences; and 2) gather pilot data on the association between sleep disturbance and maternal-infant outcomes. Nulliparous women who do not intend to conceive in the next 18 months, who intend to conceive in the next 18 months, and who are currently in their first trimester, will be recruited to participate in a 16-18 month study. Both sleep continuity and sleep disorder symptoms will be systematically tracked in relation to maternal and infant outcomes (e.g., fatigue, sleepiness, mood disturbance, gestational diabetes, incidence of pregnancy loss, incidence of pre-term birth, and birth weight). Students will be primarily responsible for assisting with study implementation and data collection. Students may also have opportunities to receive specific training in polysomnography, behavioral sleep medicine/treatments for insomnia, and correlates of sleep (e.g., aging, stress physiology). Professional development (i.e., grad school prep) opportunities will also be available to students. Students with a particular interest in sleep research or behavioral medicine are particularly encouraged to apply. Ivan Vargas, PhD, postdoctoral fellow in UPenn's Center for Sleep and Circadian Neurobiology, will also be involved in the mentoring components of this program.

Project 3: Pilot study on the Mechanisms of the Behavioral Pharmacotherapeutic strategy for Insomnia

In the present pilot study we propose to re-assess the application of the partial reinforcement (PR) strategy in older adults with insomnia disorder using 5mg of zolpidem and a 50% PR rate. In addition we will evaluate the moderating effects of 1) Phase 1 priming (is this required to allow for Phase 2 partial reinforcement?) and 2) patient awareness regarding when the doses taken are full or variable (5mg vs. 0mg). This evaluation not only holds the promise of informing

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us as to what is and is not necessary for the use of placebos in active medication regimens but also will potentially substantiate a core concept behind the behavioral pharmacotherapeutic strategy: that the vehicle for an active medication can be conditioned to elicit therapeutic effects. Students will be primarily responsible for assisting with study implementation and data collection. Students may also have opportunities to receive specific training in polysomnography, behavioral sleep medicine/treatments for insomnia, and correlates of sleep (e.g., aging, stress physiology, pharmacotherapeutics). Professional development (i.e., grad school prep) opportunities will also be available to students. Students with a particular interest in sleep research or behavioral medicine are particularly encouraged to apply. Ivan Vargas, PhD, postdoctoral fellow in UPenn's Center for Sleep and Circadian Neurobiology, will also be involved in the mentoring components of this program.

Chris Pierce

Project 1: Effect of optogenetic stimulation of nucleus accumbens D1-containing vs. D2-containing neurons on reinstatement of cocaine-seeking

The nucleus accumbens is a brain region that is highly implicated in cocaine self-administration and reinstatement of cocaine-seeking behavior. Medium spiny neurons in the nucleus accumbens can be differentiated by the expression of dopamine D1 receptors vs. D2 receptors which send projections via the direct vs. indirect pathway, respectively. However, technical limitations previously prohibited investigation into the effect of selectively activating or inhibiting D1-expressing vs. D2-expressing neurons in the nucleus accumbens on complex behaviors, including rat cocaine self-administration and extinction/reinstatement. This project utilizes newly developed transgenic rat lines which express Cre recombinase in D1-containing or D2-containing neurons. Light-sensitive ion channels (channelrhodopsins) will be delivered to specific neuron populations by Cre-dependent viral vectors, which enables optogenetic stimulation selectively in those neurons. The goal of this project is to combine optogenetics with transgenic rat lines to manipulate activation of specific neurocircuitry and, ultimately, to modulate cocaine-seeking behavior. A mentee would contribute to breeding and genotyping transgenic rats as well as assessment of behavioral (locomotor activity, cocaine self-administration and extinction/reinstatement) and immunofluorescent (YFP tag to indicate virus expression, markers of neuronal activation) outputs following optogenetic stimulation of the nucleus accumbens.

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Laurie Zandberg

Project 1: Testing the feasibility and utility of a mobile application "PE Consultant" in improving supervision resources for providers trained in treatments for PTSD

This project is a qualitative, non-randomized pilot study examining the utilization and helpfulness of a mobile training tool to help providers trained in Prolonged Exposure for PTSD feel more competent and comfortable using this highly effective treatment for PTSD in their individual community settings. The study provides free access to the mobile training tool to participating providers for a 6 month period, with periodic questionnaires (using REDCap) and qualitative feedback interviews (via phone) at 1 month, 3 months, and 6 months after the participant is given access to the application. The PURM student involved in this study will be part of recruitment efforts of community therapists into the study, will learn how to give feedback, reminders and technological assistance in using the mobile app, will be involved in the data analysis of outcomes from using the app, and will also be involved in the preparation of larger grant applications based on this study's initial data. The application has already been developed and the study has been approved by the IRB; the PURM student will be encouraged to analyze and present some portion of the study results (qualitative or quantitative) at the end of the PURM session in poster format. Study investigators Dr. Anu Asnaani and Dr. Laurie Zandberg would provide mentorship and guidance throughout the PURM experience.

Project 2: Written Exposure Therapy for PTSD: Task Shifting to Non-Specialized Facilitators

This project is an open clinical trial that will evaluate the effectiveness of Written Exposure Therapy for PTSD when provided by BA-level facilitators. Task-shifting is an implementation strategy that expands the health-care workforce by redistributing service delivery tasks to individuals with fewer credentials and less specialized training, with the ultimate aim of increasing access to evidence-based treatments. The current project will investigate the feasibility, acceptability, and efficacy of using a task-shifting approach to a brief, evidence-based PTSD treatment. The PURM student will have the opportunity to assist in recruitment efforts, study coordination tasks, data collection, and data entry. In addition, the PURM student will have the opportunity to attend group supervision meetings and will be trained to conduct fidelity ratings of Written Exposure Therapy sessions. Study investigator Dr. Laurie Zandberg will provide mentorship and guidance throughout the PURM experience.

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PSYCHOLOGY

Matthew Hocking

Project 1: Social Outcomes of Childhood Cancer Survivors

Pediatric brain tumor survivors experience social adjustment difficulties (e.g . fewer friendships, poorer acceptance) compared to peers and other groups, yet little research has examined predictors of their social adjustment, particularly longitudinally. This project is a longitudinal study that aims to 1) prospectively compare components of social information processing between pediatric brain tumor and non-central nervous system solid tumor survivors over time; 2) examine the associations between components of social information processing and social adjustment over time for both groups; and 3) examine the influence of risk and resilience factors (treatment intensity, family functioning, parent-survivor relationship quality) on aspects of survivor social information processing and social adjustment among both groups over time. A student working on this project would gain experience with participant recruitment, data collection, and data management and analysis.

Project 2: Underlying Neuroanatomical Processes Related to Social Impairments in Pediatric Brain Tumor Survivors

Pediatric brain tumor survivors experience social adjustment difficulties (e.g . fewer friendships, poorer acceptance) compared to peers and other groups, yet little research has examined underlying brain mechanisms for their social information processing difficulties. This project is a collaboration with the Center for Autism Research at the Children' s Hospital of Philadelphia and employs neuroimaging methodologies to compare functional and structural magnetic resonance imaging (MRI) data of pediatric brain tumor survivors with both youth with autism spectrum disorder (ASD) and typically developing (TD) youth. Groups also will be compared on measures of social attention and facial expression recognition. The aims of the project are 1) to compare the neural connectivity patterns in the social brain both during rest and during social processing tasks between groups using functional MRI (fMRI); 2) compare the white matter integrity of the groups using diffusion tensor imaging (DTI); and 3) examine associations between neural connectivity patterns, white matter integrity and social information processes within pediatric brain tumor survivors. A student working on this project would gain experience with participant recruitment, data collection, neuroimaging methodologies, and data management and analysis.

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PULMONARY, ALLERGY AND CRITICAL CARE

Vera Krymskaya

Project 1: Assist with launch and data collection for international patient registry study

Idiopathic multicentric Castleman disease (iMCD) is a deadly inflammatory disorder that is as common as ALS and more deadly than lymphoma, because it is so poorly understood. One of the greatest barriers to successfully treating iMCD has been the lack of a database to track treatments and patient care, leaving physicians to make care decisions with limited data. I have secured a large grant to solve this problem by creating a global natural history registry of iMCD and other subtypes of Castleman disease called "ACCELERATE." It will collect real-world demographic, clinical, laboratory, patient-reported outcomes, and treatment data on patients with CD. Such a registry could help to guide physicians in making more informed, evidence-based decisions when treating patients with CD.

Construction of the registry is currently in its final stages and a limited number of patients have been invited to test it for functionality and user experience. Before the registry is ready to be launched widespread, by the end of summer 2017, we will need to optimize the system based on what we learn from these initial enrollees and their corresponding imported clinical data. This project will be interesting to students, because they will be able to work with a variety of stakeholders (physicians, pharmaceutical companies, patient advocates) involved in the registry and the work over the summer will be essential for the success of this important project. Successful data entry and curation over the course of the summer could lead to co-authoring a manuscript in a peer-reviewed journal about registry data collection methods. As Principal Investigator of this study, I will ensure that the student is exposed to a variety of aspects of this complex project.

Project 2: Assist with collection, analysis and interpretation of clinical datasets from flow cytometry

Idiopathic multicentric Castleman disease (iMCD) is a deadly inflammatory disorder that is as common as ALS and more deadly than lymphoma, because it is so poorly understood. The cause of the immune activation, pathological immune cell type, and pathways are unknown. I am collecting medical records on patients diagnosed with iMCD for entry into a natural history registry. Many of these records contain clinical flow cytometry datasets. This first stage of this project would be to extract, analyze and interpret these datasets in the context of the patient's medical records. I am looking for an undergraduate student to assist with these tasks, and I will provide close mentorship and instructions for all analyses. This project will be interesting to students because they will be on the cutting edge of medical research and assist with turning big data into important insights to help patients. The student will complete the analysis by the end of

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the summer, which would be incorporated into a forthcoming manuscript describing immune abnormalities in iMCD. In parallel with this first stage, the student will also assist with prospective sample collection for flow cytometry to test hypotheses generated from stage one. If time allows, the student would be able to assist in the design and conduct of these studies.

Project 3: Assist with collection, analysis and interpretation of clinical immunohistochemistry of patients' lymph node and bone marrow slides

Idiopathic multicentric Castleman disease (iMCD) is a deadly inflammatory disorder that is as common as ALS and more deadly than lymphoma, because it is so poorly understood. The cause of the immune activation, pathological immune cell type, and pathways are unknown. I am collecting medical records on patients diagnosed with iMCD for entry into a natural history registry. Many of these records contain clinical immunohistochemistry slides of patients' lymph nodes and bone marrow. This first stage of this project would be to extract, analyze and interpret these datasets in the context of each patient's medical records. I am looking for an undergraduate student to assist with these tasks, and I will provide close mentorship and instructions for all analyses. This project will be interesting to students because they will be on the cutting edge of medical research and assist with turning big data into important insights to help patients. The student will complete the analysis by the end of the summer, which would be incorporated into a forthcoming manuscript describing immune abnormalities in iMCD. In parallel with this first stage, the student will also assist with prospective sample collection for immunohistochemistry to test hypotheses generated from stage one. If time allows, the student would be able to assist in the design and conduct of these studies.

Nuala Meyer

Project 1: Clinical risk factors for Sepsis-Associated Acute Respiratory Distress Syndrome (ARDS) and Mortality

This project is a great opportunity for students who wish to experience clinical research. Students will gain experience in clinical and translational research and obtain a basic understanding of sepsis (infection + a new organ dysfunction) in the ICU. In addition, students will experience clinical cohort operations and testing associations in an observational setting. The focus of this project is to determine clinical and molecular risk factors for sepsis outcomes. Delirium is one important sepsis outcome that is also a risk factor for mortality. Assessing delirium at the bedside involves interacting with critically ill patients to gauge their attentiveness and their cognitive organization with a simple set of questions called the Confusion Assessment Module adapted for the ICU (CAM-ICU). The student will collect this information for patients enrolled in the Molecular Epidemiology of Severe Sepsis in the ICU (MESSI) cohort study. The student may also learn to assess muscle mass by ultrasound in order to assess whether muscle stores influence functional recovery. Students will be taught to extract infection related to the patient's infection,

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medical history, physiologic state, and response to treatment while in the ICU from the medical record and to record this information in a computerized database. Students will also: assist with chest X-ray reading and collecting of data and attend lab meetings to discuss ongoing projects, analyses, and manuscripts in progress. Prerequisites: Students should be enthusiastic about working with critically ill patients and their families; professional and adherent to patient privacy standards, and interested in clinical/translational research.

Project 2: Molecular risk factors for Sepsis-Associated Acute Respiratory Distress Syndrome (ARDS)

This project provides the opportunity for a focused translational research experience, meaning that the student will be applying molecular techniques to human biosamples from our sepsis cohort MESSI (see above). Our group has previously identified plasma proteins that are highly associated with ARDS, a condition of severe respiratory failure. This project will test whether the whole blood gene expression of patients in septic shock reveals a signature associated with ARDS. A secondary focus may include testing a new drug for its ability to improve permeability and alter signaling in explanted human lungs under experimental conditions. The skills obtained from this experience will include: RNA extraction from whole blood; ELISA and Bradford technique protein quantification, and potentially Western blotting for qualitative protein identification. As the project progresses, there may be additional opportunities to learn techniques like real time PCR for mRNA quantification or for immunohistochemistry. Prerequisites: Students should be interested in translational research and should have completed college-level chemistry. Prior laboratory experience is preferred but not required. Students will need to adhere to standards for handling of biologic fluids and for maintenance of patient privacy.

RADIOLOGY

Terence Gade

Project 1: In Vivo Imaging of Cancer Dormancy Using Hyperpolarized Magnetic Resonance

Advances in the understanding of tumor biology have led to the development of targeted therapies which have improved response rates and transformed the prognoses of certain cancers from terminal into chronic diseases; however, improved survival has been accompanied by an associated increase in local recurrence and metastatic disease. These recurrences arise from tumor dormancy wherein remnant cancer cells persist without detectable growth by current imaging methods. Given that the majority of cancer-related deaths result from metastatic disease,

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the ability to distinguish and target dormant cancer cells will be critical in transforming cancer prognoses from chronic disease to cure. Current imaging technologies focus on features of actively proliferating cells, such as tumor growth and vascularity, resulting in a deficiency in the ability to detect residual, dormant cancer. This deficiency reflects a fundamental mismatch between conventional imaging approaches and the biology they seek to characterize underscoring the importance of developing imaging technologies based on focused characterization of the underlying biology.

This project seeks to address this challenge by leveraging the clinical imaging phenotype of post-therapy tumor dormancy to characterize the metabolic alterations enabling this survival. These findings will be utilized to develop a metabolic magnetic resonance imaging paradigm capable of distinguishing dormant cancer cells from proliferating or necrotic tumor cells using a new technique called dynamic nuclear polarization. This goal requires a multi-disciplinary approach integrating physics and engineering with cancer biology and biochemistry.

The student will work together with our team including an MD-PhD student, Nick ,as well as our staff Scientist, Dan Ackerman. While there is no prerequisite, a general familiarity in cell culture, animal work and/or nuclear magnetic resonance would be helpful. Student responsibilities will include assisting in the performance of cell culture and/or animal experiments, data analysis as well as general lab duties.

Project 2: Development of a Characterization of a Novel Coaxial Electrochemical Ablation Device for the Locoregional Treatment of Hepatocellular Carcinoma

Hepatocellular carcinoma (HCC) is the most common type of primary liver cancer with an incidence of 667,000 cases per year. Liver cancers, as a whole, have a 5-year survival rate of 8.9% even when aggressively treated using conventional modalities. Presently, the interventional radiologist has multiple percutaneous modalities to treat HCC and hepatic metastases, including percutaneous radiofrequency ablation and cryoablation. However, these thermal ablation modalities present important drawbacks, including: unintended injury to surrounding healthy parenchyma, inability to customize the shape of the ablation zone, and limited ability to monitor progress of the ablation in real-time. The most important drawback of thermal ablation is the risk for tumor recurrence from inadequate heat delivery due to heat-sinking to hepatic vessels (3,8). A proposed novel device, the coaxial probe electrochemical (CoPE) ablator, has the potential to mitigate the issues associated with the thermal ablation techniques because rather than thermal energy it utilizes direct current between adjustable metal electrodes to create a shapeable ablation zone (9–13). While the concept of the CoPE ablation device has been developed and undergone preliminary testing, it has not been fully developed for clinical application due to slow ablation times, inability to monitor ablation intraoperatively, and device designs incompatible with ablation zone shape adjustment. The project focuses on the hypothesis that a CoPE ablator can be created that allows modification of the ablation zone shape, achieves ablation rates similar to current thermal modalities, and is MRI-compatible to allow real-time ablation monitoring.

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Aims:

1. Evaluate and optimize electrochemical ablation parameters (electrical current and voltage level, pH modulation using saline, and ablation zone shape adjustment) in normal swine liver under real-time MRI.

2. Restructure the anode / cathode cage so that it can create irregularly-shaped ablation zones intraoperatively and applicable for percutaneous use.

3. File new intellectual property claims that emerge from iterating the prototype.

The student will work together with our team including a medical student pursing a Masters in Translational Medicine, Elliot Stein, and MD-PhD student, Nick Perkons, and a post-doctoral researcher, Joe Wildenberg. While there is no prerequisite, a general familiarity in cell culture, animal work and/or bioengineering would be helpful. Student responsibilities will include assisting in the performance of ex vivo and/or animal experiments, data analysis as well as general lab duties.

Project 3: Development of a Novel Bispecific Antibody for Catheter CRISPR Based Genome Editing to Enable Functional Precision Medicine in Hepatocellular Carcinoma

The majority of patients with hepatocellular carcinoma (HCC) present with unresectable disease and a life expectancy of approximately 6 to 20 months, with a mere 15% of these patients surviving more than one year after diagnosis. This dismal prognosis underscores the limited therapeutic options for these patients. HCC is a notoriously chemoresistant malignancy, and despite substantial investments in research and development by large pharmaceutical companies, advances in molecular medicine targeting the genetic mutations underlying HCC have been unsuccessful in improving survival. This limitation issues from the variation in genetic mutations from patient to patient. The proposed project seeks to address this challenge by developing a precision medicine paradigm that can be integrated into current care models for the diagnosis and treatment of HCC patients. This paradigm will apply advances in clustered regularly interspaced short palindromic repeats (CRISPR) genome editing to identify druggable vulnerabilities in cells from biopsied HCC samples that will enable the repurposing of existing FDA-approved therapeutics on a patient-by-patient basis.

The student will work together with our team including the laboratory of Junwei Shi in Cancer Biology and a staff scientist, Dan Ackerman. While there is no prerequisite, a general familiarity in cell culture, animal work and/or immunology would be helpful. Student responsibilities will include assisting in the performance of in vitro cell culture experiments, data analysis as well as general lab duties.

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Chamith Rajapakse

Project 1: Musculoskeletal MRI and Biomechanics

We are investigating the feasibility of personalized 3D printing of bone using images obtained from high-resolution MRI in human subjects and mesenchymal stem cell (hMSC) engraftment onto the same 3D-printed surfaces as a mean to further improve post-implant outcomes. Responsibilities include MRI scanning, image analysis, fabrication, and biological/mechanical testing of printed models. Training will be provided. Students interested in working beyond summer are encouraged to apply. Ideal for students interested in medical school and/or academic career. Continuation after summer could be discussed if interested.

Project 2: 3D printing of Orthopaedic Implants using MRI ***Both only***

We are developing methods to non-invasively predict bone fracture risk in patients using high-resolution MRI-based personalized biomechanical simulations. This project involves imaging of human subjects as well as validation studies in cadaveric bone. Responsibilities include MRI scanning, image analysis, mechanical testing of bone samples in the orthopaedic lab. Training will be provided. Students interested in working beyond summer are encouraged to apply. Ideal for students interested in medical school and/or academic career. Continuation after summer could be discussed if interested.

Project 3: Molecular Imaging of Cancer and Bone Disease using PET/CT/MRI ***Both only***

This relatively new project involves development of novel PET/CT/MRI methods for applications in cancer and bone disease. Responsibilities include the generation, analysis of imaging data and publication of results. Training will be provided. Students interested in working beyond summer are encouraged to apply. Ideal for students interested in medical school and/or academic career. Continuation after summer could be discussed if interested.

Ronnie Sebro

Project 1: Pediatric bone and soft tissue sarcomas

Team sarcoma works on understanding how the image appearance of bone and soft tissue tumors correlate with overall clinical outcome and prognosis. We also attend the annual Sarcoma walk and get to meet patients and animals with sarcomas. Students will learn about medicine -

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oncology, radiology, pathology, and orthopedic management of these tumors. Students generally will be able to produce one peer reviewed publication.

Project 2: Genetics of adult and pediatric sarcomas

Team sarcoma works on understanding how the image appearance of bone and soft tissue tumors correlate with tumor genetics. We also attend the annual Sarcoma walk and get to meet patients and animals with sarcomas. Students will learn about genetics, medicine - oncology, radiology, pathology, and orthopedic management of these tumors.

Project 3: Morphometrics

Here we assess how bone morphology affects common musculoskeletal diseases. Students will learn about anthropology, evolutionary biology, anatomy, radiology and orthopedics

Joel Stein

Project 1: Quantification of hippocampal digitations in temporal lobe epilepsy using high-resolution MRI

The hippocampus is a brain structure that subserves learning and memory function and is also a common site of seizures in patients with epilepsy. Hippocampal digitations are undulations along the surface of the hippocampus. Loss of this morphologic feature is one marker of mesial temporal sclerosis (MTS), a common and treatable cause of temporal lobe epilepsy. Magnetic resonance imaging (MRI) at higher magnetic field strength permits better visualization of hippocampal digitations. The goal of this project is to develop an automated method to determine the number and thickness of hippocampal digitations from high resolution MRI. The approach will be validated against expert manual determination in an existing 7 Tesla brain MRI dataset of epilepsy and control patients. A validated automatic method for measuring digitations could be used in larger datasets to determine whether the number of digitations is correlated with MTS, hippocampal atrophy, behavioral factors or genetic features. This project offers the opportunity to work with state-of-the-art neuroimaging data on a problem of high clinical relevance, and upon successful execution would likely lead to at least a conference abstract. The project will be co-mentored by Dr. Joel Stein (Radiology) along with Dr. Kathryn Davis and Dr. Sandhitsu Das (Neurology).

Familiarity with basic statistical methods is recommended. Programming experience such as in Matlab, C++, or Python would be helpful.

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Walter Witschey

Project 1: Cardiac magnetic resonance imaging of myocardial infarction

Heart failure (HF) is an enormous health burden affecting approximately 5.1 million people in the US and is the cause of 250,000 deaths each year. Approximately 50% of HF is caused by myocardial ischemia and requires immediate restoration of coronary blood flow to the affected myocardium. However, the success of reperfusion is partly limited by intramyocardial hemorrhage (IMH), which is the deposition of intravascular material into the myocardium. Hemorrhagic reperfusion injury has high prevalence and patients have a much greater risk of adverse left ventricular remodeling, risk of fatal arrhythmia, impaired systolic function and are hospitalized at a greater rate. Recent magnetic resonance imaging techniques have improved assessment of reperfusion injury, however, the association between MRI contrasts and reperfusion injury is highly unclear, lacks specificity to IMH, and techniques are plagued by imaging artifacts caused by motion, long scan times, and background field heterogeneity. Improved imaging of IMH and accurate knowledge about its spatial and temporal evolution may be essential for delivery of optimal medical therapy in patients and critical to identify patients most at risk for adverse ventricular remodeling. The overall goal is to investigate the magnetic properties of IMH and develop MRI techniques with improved specificity to infarction and IMH in patients after reperfused myocardial infarction (MI). New MRI techniques permit noninvasive assessment of the magnetic susceptibility of tissues and have improved specificity to infarction fibrosis. Therefore, we hypothesize that MRI parametric methods can provide quantitative noninvasive measurement of hemorrhagic reperfusion injury and are predictive for adverse LV remodeling. We will perform preclinical experiments in a pig model of reperfusion injury to validate these methods and a clinical pilot study in ST-elevation MI patients to assess the feasibility of mapping the magnetic properties of hemorrhage.

The student will be mentored by a senior Ph.D. graduate student in Bioengineering or by a postdoctoral fellow in Dr. Witschey's lab. The student will collect magnetic resonance imaging (MRI) data and analyze it using software/algorithms in Matlab. Prerequisites are linear algebra, multivariable calculus, and computer programming or similar coursework. There will be opportunities to contribute to publications.

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SURGERY

William Peranteau

Project 1: Enhacing allogeneic engraftment following in utero hematopoietic stem cell transplantation in a mouse model

In utero hematopoietic cell transplantation (IUHCT) takes advantage of normal fetal development to allow for the transplant of hematopoietic stem cells (HSCs) across immune barriers (i.e. a mismatched bone marrow transplant) without toxic immunosuppressive or myeloablative conditioning. It has the potential to treat a number of congenital hematologic and genetic disorders, such as Sickle Cell disease, which can be prenatally diagnosed and for which the only cure is a postnatal bone marrow transplant. Unfortunately, the postnatal bone marrow transplant requires toxic immunosuppressive and myeloablative conditioning and a immunologically matched bone marrow donor. Thus, many patients are not eligible for this treatment. If successful, IUHCT could significantly expand the number of patients eligible for a bone marrow transplant and potentially cure the target disease prior to birth and onset of symptoms. One of the main limitations to successful clinical IUHCT is low levels of donor cell engraftment secondary to competition from endogenous (recipient) fetal HSCs for limited space in the hematopoietic compartment of the fetus. The goal of this project is to study clincally relevant mechanisms to provide a competitive engraftment advantage to donor cells prior to IUHCT and thus enhance the level of donor cell engraftment after birth. This is studied in our lab in a mouse model of IUHCT. Different approaches to provide a competitive advantage to donor cells include treating the donor cells with agents that enhance their homing to the fetal hematopoietic compartment and/or treating the fetal recipient with agents that impair the function of their endogenous HSCs.

Student duties, responsibilities, and anticipated skills, experiences, and benefits include:

The student will learn the process of harvesting and processing bone marrow, what is involved in sterile technique required for surgical procedures, dissecting and analysis of fetal tissues and adult murine bone marrow/blood by flow cytometry, and data storage and analysis.

The student will work closely with myself as well as general surgery residents who spend 2-3 years rotating through the lab and often medical students doing rotations in the lab at the Center for Fetal Research at CHOP. This exposure will provide a unique insight and mentoring from a surgical attending with both a research and clinical practice as well as trainees at different stages of their careers as the undergraduate student explores the possibilities of different career paths.

Project 2: In utero gene therapy for the correction of congenital genetic anomalies

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Advances in prenatal imaging and treatment now allow for the diagnosis of most genetic abnormalities prior to birth. The improvement in the prenatal diagnosis of genetic abnormalities combined with advances in gene therapy, including novel gene editing techniques such as CRISPR-Cas9, provide hope for the potential to treat congenital disorders resulting from genetic mutations with prenatal gene therapy or gene editing. The normal development of the fetus is such that progenitor cells, which would be the target for any gene editing or gene therapy approach, are more accessible and more proliferative. These characteristics suggest that application of gene editing/therapy techniques to the fetal environment may be more efficient and have a greater therapeutic potential compared to postnatal applications. Despite the promise much work is required to study the safety and efficacy of in utero gene therapy/editing. In this project, we evaluate the efficiency of in utero gene therapy/editing in normal and disease mouse models.

Student duties, responsibilities, and anticipated skills, experiences, and benefits include:

The student will learn what is involved in sterile technique required for surgical procedures. They will become facile with dissecting of adult and fetal tissues and learn techniques involved in the analysis of the tissues including immunohistochemistry, immunofluorescent histology, and flow cytometry.

The student will work closely with myself as well as general surgery residents who spend 2-3 years rotating through the lab and often medical students doing rotations in the lab at the Center for Fetal Research at CHOP. This exposure will provide a unique insight and mentoring from a surgical attending with both a research and clinical practice as well as trainees at different stages of their careers as the undergraduate student explores the possibilities of different career paths.

Paige Porrett

Project 1: Response of maternal immune cells to the fetus during pregnancy

In my immunology laboratory, we use a mouse model of transplantation and pregnancy study how cells of the maternal immune system respond to tissue antigens of the fetus during pregnancy. The fetus is genetically "foreign" enough to look like a special kind of transplant. However, it is not rejected like a transplant. The immunologic mechanisms that establish this fetomaternal tolerance are largely unknown but may provide the key to understanding how to establish tolerance to organ transplants. We are interested in a variety of cell populations including memory T cells and B cells that produce antibody. Students will learn a variety of important immunologic techniques, including ELISA, flow cytometry, and special transgenic mice that allow us to track populations of cells that only recognize the fetal antigens we designate. No pre-requisites required.

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Nursing

BIOBEHAVIORAL HEALTH SCIENCES

Therese Richmond

Project 1: Prospective Study of Racial and Ethnic Disparities in Chronic Pain and Pain Burden

I invite you to join our team in a new research study funded by the National Institute of Minority Health Disparities. The objective is to improve knowledge regarding which, of the many mechanisms posited to underlie chronic pain disparities, are potentially promising candidates around which to design prevention and intervention efforts to reduce racial/ethnic pain disparities. Specifically, we are studying pain disparities in the context of sudden physical injury requiring emergency medical intervention. Penn is one of two study sites. We are enrolling 500 adult physical injury survivors with a range of acute injuries, comprised of African-Americans, Latinos, and non-Latino Whites. We recruit, enroll, and conduct the first interview in the trauma center at Penn Presbyterian Hospital and subsequently at 3- and 12-months after hospital discharge.

You will join an established research team and seasoned staff. We will train you in the responsible conduct of research and train you to conduct interviews with our participants during their acute hospitalization. You may also accompany staff to participant's homes to conduct follow-up interviews. You will be able to assist our team with literature reviews and development of presentations and publications related to our portfolio of research in seriously injured patients. I will engage you in the broader scholarly community of our CDC-funded Penn Injury Science center. You will be invited to participate in the center's monthly research meetings and interact with our students, post-doctoral fellows, and faculty who represent a variety of disciplines including emergency medicine, surgery, nursing, epidemiology, criminology, design, and economics.

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FAMILY AND COMMUNITY HEALTH

Bridgette Brawner

Project 1: HIV/STI Prevention for Black Youth *Rising Sophomore only*

This project is a secondary analysis of data from a CDC-funded randomized controlled trial. The HIV/STI prevention program was conducted with Black youth aged 14 to 17 years old in the city of Philadelphia. The comprehensive dataset includes information on factors such as sociodemographics, mental health diagnosis and treatment, emotion regulation, sexual risk behaviors and health behavior practices (e.g., diet, exercise). Dr. Brawner is looking to mentor a rising sophomore with a budding passion for research; the hope would be to retain an interested mentee as a research assistant on additional projects throughout the academic year. Prior research experience is not required. Duties/responsibilities include data entry, assistance with quantitative and qualitative data analyses, literature reviews and assistance in the development of grants and publications. Co-authorship opportunities are available for those interested in developing skills in peer-reviewed publications. The student will also be mentored in conducting community-engaged research, and will have an opportunity to work on presentations and organize community advisory board meetings to disseminate the study findings within the local community. Those interested in independent research projects that are an offshoot from the parent study will be supported to recruit participants from our existing database. For example, if the quantitative secondary analyses reveal interesting findings that warrant additional interviews or focus groups to better understand a given phenomenon, Dr. Brawner would work with the student to accomplish the tasks associated with their line of inquiry (e.g., interview guide development).

Catherine McDonald

Project 1: Examining Adolescent Driving Behaviors

Motor vehicle crashes are the leading cause of death in adolescents. Passengers, texting, phone calls and mobile phone apps can take a teen's attention away from the roadway. Our research team has tested a web-based intervention for distracted driving by using driving simulation and in-vehicle monitoring of cell phone use while teens drive on the road. We seek a well organized and self-directed student to assist in our data analysis of the in-vehicle monitoring data and simulation data. Training will be provided and the candidate will gain skills in human subjects research, web-based intervention delivery, cell-phone monitoring, interdisciplinary communication, and scholarly presentation. We are excited to welcome a student to our team that

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combines nursing, medicine, engineering and public health. You will interface with study staff at CHOP and PENN, and will need to complete all required background checks.

Robin Stevens

Project 1: Using Social Media for Sexual Health ***Rising Junior only***

The Health Equity and Media lab at the University of Pennsylvania School of Nursing is home to research studies examining health and risk behavior in the context of the digital, media and social environments. We are currently investigating social media use among minority youth to communicate messages about sexual behavior, substance use, violence, and mental illness. Summer research assistants will examine and analyze social media content and conduct online and/or focus group research to assess social media usage behaviors. This information will be used to develop sexual health intervention strategies using digital media. We are looking for inquisitive students, with strong familiarity with social media and experience working with African American and/or Latino/a youth.

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Social Policy and Practice

SOCIAL WORK

Ram Cnaan

Project 1: Coexistence nonprofit organizations in Israel: NGOs that bridge Jews and Arabs

Dr. Cnaan leads a Penn summer course in Israel. In collaboration with the Hebrew University in Jerusalem, he runs a course on nonprofit organizations' contributions to peace and coexistence. This research project involves analyzing the characteristics of all registered peace and coexistence NPOs. Currently, we are comparing organizations that have ceased operations with surviving organizations, attempting to understand why some perished while others did not.

Project 2: International comparison of episodic volunteering (a 20-country study)

Episodic volunteering is popular among busy people. These volunteers may come for one day or one weekend and then disappear. Little is known about who they are and how to manage them. A group of scholars from 20 countries will collaborate to answer these questions.

Project 3: International comparative analysis of the role of religion and national culture of prosocial behaviors

In this study, we assess the impact of national culture on giving and volunteering. We add a national culture variable to a large dataset from the Gallup Organization.

Femida Handy

Project 1: Intergenerational transfer of environmental values

The proposed research is a cross-national comparative investigation of intergenerational transmission of environmental behaviors. To date research conducted on the motivation to engage in pro-environmental behavior shows that individual demographic determinants, such as age, gender, or socio-economic status, and the distinction between self-interested/economic and altruistic motivations do not fully explain the differences between individuals who adopt pro-environmental behavior and those who do not (Buttel 1987; Jones and Dunlap 1992; Dietz et al. 1998). We therefore propose an alternative approach focusing on the question: to what extent do external influences – more specifically intergenerational family relationship and country context – associate with pro-environmental behavior? In developing our alternative framework for

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explaining the factors influencing environmental behavior, we are guided by past theoretical work in environmental sociology and psychology that examined individuals' abilities and opportunities for action as well as their values and attitudes (e.g., Gatersleben and Vlek, 1998; Guagnano et al., 1995; Ölander and Thøgersen, 1995; Oreg and Katz-Gerro, 2006).

Intergenerational family relationship: This component will focus on the transmission of environmental attitudes and behaviors that occurs within the family across generations. Recent scholarly attention finds that children's environmental orientations are related to their parents' environmental values, attitudes, and behaviors (Arnold et al., 2009; Ballantyne et al., 2001; Gentina and Muratore, 2012; Grønhøj and Thøgersen 2009). Individuals' lifestyles, consumption patterns, and environmental behaviors are shaped to a large degree by practices adopted early on in the life of a person, mainly through family socialization. We will investigate environmental behaviors and orientations of three generations, which we refer to as grandparents (G1), parents (G2) and children (G3). This will allow us to ask if and how individuals' environmental behaviors are transmitted through generations. To put it differently, a guiding question in this line of research is whether children's environmental behavior is predominantly the outcome of their own environmental attitudes or the product of social influences within the family. We label this mechanism as 'environmental habitus.'

Country context: Environmental behaviors might also be influenced by external events and conditions in a specific cultural context, which results in different framings of environmental issues and practices. This implies that individuals are subject to effects that are location- and time-specific (Büttner and Grübler, 1995). As we examine intergenerational effects, it is important to bear in mind that each generation faces a different framing of environmental issues that might impact their behavior in addition to that transmitted from the previous generation (Inglehart, 1977, 1990). To understand this impact, we propose to conduct this study in three countries, so we can compare period effects and cultural influences at the country level, as well as family socialization -- the environmental habitus argument. In particular, we argue that various indicators of economic development (see below the empty belly / full stomach thesis), socio-cultural conditions, and societal environmental awareness in each country at specific time periods, exert different influences over members of each of the three generations. By studying three generations in three countries, we will be able to examine and account for the cultural influences of different contexts and the resulting intergenerational transmission of environmental behaviors.

Student responsibilities: help with several aspects of research: coordination, facilitation of focus groups, writing up of field notes, editing, instrumentation for national survey, coordinating with either Gallup poll or Harris polls in conducting survey and administrating aspects of this data gathering aspects

Project 2: Ethics of social impact- book manuscript

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Introduction: Why Ethics? (This introduction will also include a brief discussion of recent nonprofit scandals to get readers thinking about the topic as it relates to recent events and issues.)

Part I: Theoretical Framework, Chapters 2-5

2. Foundations/Frameworks for Ethical Decision-Making (theory-driven; reviews the literature)

3. Multiple Stakeholders and Multiple Bottom Lines (introduces a central and complicating factor for the study of ethics in nonprofit organizations, and recognizes that similar quandaries arising in the for-profit and public sector with different outcomes)

4. Roadmap to Making Ethical Decisions (provides an approach to integrating ethical frameworks/theory into practice)

5. Codes of Ethics in Nonprofit Organizations (discusses the development of codes of ethics in nonprofit organizations and how they can be used to enhance ethical decision-making)

Part II: Case Studies (organized thematically), Chapters 6-10

Because there will be 15 cases, I intend to organize the cases thematically into 5 chapters (likely 3 cases per chapter). Each chapter will include a brief overview of the theme; each case will be followed by its own unique set of discussion questions. Possible organization of themes: Ethics of leadership, including governance, fiduciary responsibilities, and "founder's syndrome"; human resources management, including staff and volunteer management and concerns related to compensation of paid staff; fundraising, including fundraising practices and donor control/influence; public versus private interests; and mission drift.

Student responsibilities: help with several aspects of research in writing this book manuscript coordination, facilitation of meetings for authors. Need excellent skills in writing and editing,

Yin Ling Irene Wong

Project 1: Community In-Alliance for Recovery: Challenging Stigma of Mental Illness in Rural China

Description of the project: Stigma is pervasive in Chinese culture, resulting in community exclusion and social isolation of persons living with mental illness (MI). In healthcare settings, negative attitudes held by professionals can have detrimental effects on the health outcomes of patients diagnosed with a mental health condition. Stigma of MI extends to family members by diminishing their role as partner for promoting mental health recovery. The goal of this project is to design and pilot a family-based health-messaging educational program to reduce stigma of MI held by healthcare professionals in Xinjin County, Chengdu, China.

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The PURM student will participate in an interdisciplinary research team consisting of mental health services researchers and healthcare professionals of Penn, the University of Hong Kong, and Xinjin Mental Hospital. Along with team members whose academic backgrounds span the fields of health communication, psychiatry, public health, social administration, and social welfare, the PURM student will participate in the following activities: 1) developing training materials based on real-life stories of families affected by MI in Xinjin County; 2) creating media for delivering the educational program using photographs, graphic vignettes, and videos; 3) exploring the use of social media to bolster the effects of the educational program.

The PURM student will learn the following academic and professional skills: 1) conducting interdisciplinary research in a cross-cultural setting; 2) using photographs, graphic vignettes, and videos to create a culturally-relevant educational program for healthcare professionals; and 3) understanding how social media can be used to reduce stigma of MI. The student will gain an understanding of the cultural meaning of MI in rural China. Proficiency in spoken and written Chinese is required for this PURM position.

Other Mentor: Dr. An-Li Wang, Assistant Research Professor, Department of Psychiatry, Perelman School of Medicine

Role: Mentoring on the development of a health-messaging educational program

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Veterinary Medicine

BIOMEDICAL SCIENCES

Montserrat Anguera

Project 1: Epigenetic profiling of the inactive X in female immune cells

Females are predisposed to develop autoimmune disorders, and the genetic basis for this resides in the X chromosome. Our lab is investigating how female lymphocytes, which are fundamental players in the immune response, regulate gene expression from the inactive X-chromosome. We are investigating the epigenetic profiles of the inactive X in a variety of immune cells from mice. Student(s) will learn how to perform RNA FISH, qRT-PCR, and immunofluorescence on sorted immune cell subsets.

CLINICAL STUDIES NEW BOLTON

Dipti Pitta

Project 1: Comparison of antimicrobial resistance genes in humans and animals

The aim of this project is to compare antimicrobial resistance gene profiles in humans and animals. Background: Antibiotic resistance is a serious public health threat. Livestock facilities are blamed for dissemination of antimicrobial resistance genes as nearly 70% of domestic consumption of antibiotics is by the livestock sector. Additionally, some of the 3rd and 4th generation critically important antibiotics that are necessary for treating serious infections are commonly used in human and animal settings thus creating the risk for emergence and dissemination of novel resistance genes. This project is first of its kind to compare cross-species to identify resistance genes, in terms of type, abundance, and change dynamics, in the fecal microbiome of dairy cattle and humans before and after antibiotic treatment. Particularly, the impact of critically important third generation cephalosporins on the antibiotic resistance gene profiles in the gastrointestinal tract of dairy cattle and humans will be determined. Specific tasks: The student will (i) review and synthesize relevant literature, (ii) participate in sample collection, DNA extraction and preparation of libraries for sequencing, (iii) understand the concepts of bioinformatics and data analysis involved in mining next generation sequencing data and (iv) write a report on the work performed by the student which will be used in manuscript

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preparation. Benefits: The student will be guided carrying out each task, gain basic research skills in critical literature review, and learn how to work in a molecular lab setting. He/she will also have the opportunity to participate in animal science conference and/or present a talk at one of the seminar series. Willing to travel to farms and work at ASMG lab located in New Bolton Center is mandatory. Prior microbial experience and data analysis is necessary but not a prerequisite.

CLINICAL STUDIES PHILADELPHIA

Cynthia Otto

Project 1: The effect of canine exercise on hydration and olfaction

Dogs and their sense of smell are critical to many life saving jobs like search and rescue and explosive detection. Dogs often have to work in adverse environments for extended periods of time. Exercise can lead to dehydration which can decrease both physical and olfactory performance. This study will work with the dogs from the Penn Vet Working Dog Center evaluating the impact of series of exercises on their hydration status and ability to detect a specific odor. The student will be involved in collecting data on the dogs' physical and biochemical parameters during the study. The student will be working with a team of veterinary students and dog trainers for this project.

Project 2: Odor threshold: how low can they go (smell)

Dogs can be trained on a wide variety of odors. Some odors are present in large amounts, while others are present at trace levels. Understanding the odor threshold, the minimum amount of odor that a dog can detect is critical to monitor factors that have the potential to interfere with olfactory performance. We are using a synthetic compound to monitor olfactory threshold in detection dogs and determine the factors that alter it. We will evaluate the effect of exercise, medication and environmental factors on olfactory threshold. The student will be involved in setting up the olfactory screening and collecting data on the dogs' performance. The student will work with our Post-doctoral fellow and student interns on the research team.

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PATHOBIOLOGY

Carolina Lopez

Project 1: Molecular determinants of a novel adjuvant activity

During RNA virus infection, pathogen-associated molecular patterns (PAMPs) allow the host's innate immune system to recognize and eliminate invading viruses. The mechanism for initiating the antiviral response requires activation of intracellular RIG-I-like receptors by defective viral genomes (DVGs), which are generated as viral replication by-products and act as PAMPs. The accumulation of DVGs at high titers of viral replication results in recognition of the virus and stimulation of antiviral immunity through promoting type-I interferon (IFN) expression. The Lopez Lab has previously identified a RNA motif, DVG70-114, that is essential for the immunostimulatory activity of DVGs. In addition to enhancing host cell recognition, DVG70-114 retains its stimulatory potential when transferred to inert viral RNA, such as the hepatitis C virus X-region RNA (HCV X-region). Despite DVG70-114 great immunostimulatory abilities, the molecular determinants of its activity remain unknown. It is still unclear whether sequences and/or structures confer the motif's functional abilities. The student working on this project will use PCR-based cloning strategies to create mutant variants of the DVG70-114 motif in the HCV X-region background to address this question. Additionally, the student will gain experience performing techniques such as transfection and RNA-qPCR analysis. The student will also become familiar with the QA/QC procedure for vaccine quality level RNA production. With thorough understanding of the molecular basis behind the DVG70-114 motif, we hope to use the motif to increase the immunostimulatory potential of otherwise inert viral RNAs and enhance the capabilities of vaccine adjuvants and antiviral therapeutics.

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Wharton

BUSINESS ECONOMICS AND PUBLIC POLICY

Judd Kessler

Project 1: Organ Donor Registration Decision Experiments

Over 120,000 people are currently on a waiting list for a life saving organ transplant, and every year over 10,000 die while waiting. The organ donation rate — i.e. the percentage of individuals 18 years of age or older who have registered as organ donors at their state DMV — is less than 50% even though 95% of people say they support organ donation. This research project aims to better understand what motivates individuals to register as organ donors by running a series of randomized controlled trials with partner organizations, varying the way people are asked to register and observing subsequent registration rates. The student will be involved in overseeing a database of research topics, identifying partner organizations, and participating in the design and analysis of experiments done as part of the research.

Project 2: Behavioral Economics to Promote Medication Adherence and Habit Formation

We aim to investigate behavioral economics interventions that can help overcome cognitive and motivational barriers to medication adherence through consumer engagement. While previous work has investigated interventions such as reminders and incentives in isolation, our goal is to study how these interventions interact. Are incentives more or less effective for subjects receiving reminders? How is habit formation affected by the interaction of these two? Does this vary by patient type? Answering these questions allows medication adherence interventions to be designed optimally. Understanding how to optimally design adherence interventions has the potential to improve patient health, thus lowering cost of care, while minimizing the cost of the intervention through effective targeting to certain patient types. We are in the middle of a study tracking daily adherence of patients to a prescribed drug using a technology that electronically monitors when a pill bottle has been opened. Our innovative study design aims to accomplish three goals: (1) promote medication adherence; (2) promote long-term habits that persist even when the interventions are removed; and (3) understand how various patient characteristics (including their beliefs about their ability to comply with their prescription) predict adherence and treatment receptivity. The student's duties will involve supporting the research coordinator in running a very large randomized control trial, potentially communicating with subjects and conducting administrative tasks.

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LEGAL STUDIES AND BUSINESS ETHICS

Peter Conti-Brown

Project 1: The Supreme Court of Finance: A History of the US Federal Reserve

I am writing a political history of the US central bank, the Federal Reserve. Students participating in this project would help me digest the very large amount of primary sources on the Federal Reserve by doing archival research and writing research memoranda on key moments in the Fed's history, including: the Fed in the shadow of Watergate, the Fed in the Cold War, the Fed and the deregulation of the financial sector in the 1980s and 1990s, and the Fed and 9/11. Students should have an interest in history and politics and feel comfortable reading and summarizing primary sources.

I will also send each student on a research trip somewhere in the US (and paid for by me) to do archival work.

MANAGEMENT

Emilie Feldman

Project 1: Divestitures: The Ugly Duckling of Corporate Strategy

Although divestitures account for close to 40% of corporate deal-making and on average, create more shareholder value than acquisitions, they are relatively understudied in the academic literature on corporate strategy. One of the major factors that prevents companies from undertaking divestitures is the persistent stigma that is associated with these deals, namely, that they reflect an inability to manage or a failure of strategy. This research project seeks to investigate the factors that contribute to large corporations' inertia against undertaking divestitures, as well as the consequences thereof. The main task for the RA will be the collection, synthesis, and analysis of industry-, company-, and manager-level data on divestitures. Economics majors or Wharton undergraduates are preferred; diligence, precision, and attention to detail are required.

Project 2: Separate in Theory, But Not in Practice: The Case of Corporate Spinoffs

Corporate spinoffs, in which a "parent company" issues shares in one of its subsidiaries to create a new, publicly-traded "spinoff company," have become an increasingly prevalent mode of divestiture in recent times. Interestingly, even though spinoffs legally separate the parent and

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spinoff companies from one another, both formal and informal ties between the two companies often persist following deal completion. This research project seeks to investigate the conditions that lead parent companies to maintain connections to the spinoff companies they divest, as well as the performance consequences of these ongoing ties. The main task for the RA will be the collection, synthesis, and analysis of Securities and Exchange Commission data on spinoffs. Economics majors or Wharton undergraduates are preferred; diligence, precision, and attention to detail are required.

Project 3: Why Did They Do It? A Taxonomy of Divestiture Motivations

Companies undertake divestitures for a number of reasons: to get rid of non-core businesses, to eliminate businesses that disrupt internal processes, to remove businesses that complicate external evaluation, to jettison underperforming businesses, or simply to respond to external forces that pressure them to do so. This research project seeks to develop a comprehensive taxonomy of companies' motivations for divestitures, and to analyze the relative performance implications of divestitures that are undertaken for different reasons. The main task for the RA will be the collection, synthesis, and analysis of data from public media sources on companies' stated motivations for divestitures. Economics majors or Wharton undergraduates are preferred; diligence, precision, and attention to detail are required.

David Hsu

Project 1: Commercializing Science: Evidence from Simultaneous Discoveries

I am recruiting for two research assistants, one with general business research skills, the other with computer programming skills. The main idea of the project is that identifying instances of scientific co-discovery provides a quasi-natural laboratory to study a variety of business decisions regarding invention commercialization. This research project studies two related questions: (1) what shapes the decision to commercialize scientific discoveries, and (2) how does the commercialization strategy of high-technology startups relate to performance outcomes? We address these questions by assembling a relatively large dataset of simultaneous scientific discoveries. Doing so helps us hold constant differences in entrepreneurial opportunities which might otherwise explain the decision to commercialize and/or the performance outcome of commercialization efforts. With regard to the first research question, the (small) prior literature has mainly studied differences in technological opportunities and characteristics in explaining commercialization decisions. By contrast, we hope to shed light on characteristics outside of differences in technological opportunity which might be operating in shaping commercialization. We do so by leveraging the scientific co-discovery dataset to hold constant the technological opportunity, and instead place the spotlight on other variables such as inventor social structure and academic institutional differences. Addressing the second research question involves collecting information on the choices associated with new firm formation for the subset of co-

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discoveries which pursued parallel (but likely different) efforts in enterprise formation to commercialize the discovery. One prominent example is the co-discovery of the gene editing tool, CRISPR/Cas9, by a team in Germany (and founders of the startup, CRISPR Therapeutics) and a team at the Broad Institute/MIT/Berkeley (founding Editas Medicine). Taking advantage of the natural variation in resource assembly and strategizing, while holding constant the technological opportunity, is at the heart of the empirical strategy relating strategy to performance at startups.

Laura Huang

Project 1: Entrepreneurs, Investors, and Impression Management

This project looks at how entrepreneurs manage the impressions of angel investors and venture capitalists. Prior research has shown that there are fundamental criteria that drive evaluations and investment decisions, such as market and financial data. However, there are also other factors that are likely to be less explicit. There are a variety of signals and cues that influence the way that potential resource providers (e.g. investors) subsequently evaluate entrepreneurs and their new ventures. Students interested in research at the intersection of entrepreneurship and social psychology are encouraged to apply. You will gain experience working with multiple types of archival data, and will learn about the entrepreneurial investment process and financial decision making. The project entails working with business plans, resumes, and investor feedback forms, as well as watching a large set of pitch presentations. Students may also be asked to participate in the design and administration of surveys, as well as the analysis of the resulting data. Strong organizational skills and attention to detail are critical.

Anoop Menon

Project 1: Applying Machine Learning to Innovation and Competitive Strategy

Innovation is a key force behind economic growth. While we have studied it for many decades, many of the intricate mechanisms that foment, direct and suppress innovation still remain a mystery. This project will use machine learning and big data techniques to create and integrate multiple large datasets in a fashion that would enable us to answer a set of basic, yet crucially important questions about the relationship between firm strategy, intellectual property rights, and innovation. What are the major strategic approaches that firms take toward innovation? How does competition impact innovation? How does firm performance impact innovation and vice versa?

To answer these questions, we will combine public databases of international patents, patent lawsuits and patent acquisitions with firm regulatory filings, reports, mergers, acquisitions and

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stock market performance. Students will be responsible for creating programming routines that extract and clean large amounts of data from various public databases, and for integrating information across these different datasets. They will be using advanced machine learning and data processing tools to achieve this, and would have the opportunity to develop new techniques to perform certain domain specific tasks (for example, disambiguating company names). Through this, they will be able to develop valuable data-science skills.

Prerequisites include prior programming experience, preferably in data scraping and big-data handling techniques, proficiency in Python, and in one or more of the following languages: R, Stata, SQL.

Samir Nurmohamed

Project 1: Projects and the Purpose Paradox in Retirement ***Rising Junior only***

We are interested in the projects that individuals pursue as they approach retirement. Although it is commonly thought that individuals will be highly satisfied after voluntarily exiting the labor force, a large portion of people still do not find satisfaction after this event occurs. One of the key reasons why this happens is that people lack a sense of purpose or meaning when they exit organizations. Our interest is learning more about the projects that people pursue as they approach and exit the labor force and retire. We are currently collecting a large dataset. Students will be responsible for synthesizing existing research, coding the data, and helping conduct empirical analyses. Ideal students will have an interest in organizational behavior, psychology, and should have appropriate statistical training (regression analyses). Students may also be asked to participate in the design and administration of additional surveys. Strong organizational skills and attention to detail are crucial.

Project 2: The Implications of being Underestimated

We are interested in learning more about what motivates individuals when they are underestimated by others. Although existing research suggests that individuals may be demotivated when others expect them to be unsuccessful, we are working on a series of studies that examines what drives people when they are not expected to succeed. Students will be responsible for synthesizing existing research, coding the data, and helping conduct empirical analyses. Ideal students will have an interest in psychology, organizational behavior, and should have appropriate statistical training (ANOVAs and regression) and be interested in conducting experiments. Students may also be asked to participate in the design and administration of additional surveys. Strong organizational skills and attention to detail are crucial.

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OPERATIONS, INFORMATION AND DECISIONS

Lynn Wu

Project 1: Big Data Analytics, Sentiment and Stock return

We plan to examine how to use text mining on various public data sources, such as letters to investors, news coverage, and earning reports and transcript to understand how to measure CEO personalities and other intangible characteristics of the firms that cannot be easily observed. When we will explore whether these characteristics can affect decisions on various performance and corporate governance issues such as risk allocations, investment in information technology, and firm performance. Student must have strong programming skills to process a large amount of unstructured text and use machine learning and other sophisticated methods to generate topic space, sentiment variables, and other underlying constructs arise from text.

STATISTICS

Abraham Wyner

Project 1: How much would a High School Football draft be worth?

The National Football League along with the NCAA and the media profit immensely off of college football players who hope to play professional football. Major League Baseball has a different system that does not exploit athletes: it has a high school draft. Top athletes who have strong professional aspirations (and the talent and skills that support those aspirations) are able to translate that potential into monetary compensation in the form of signing bonuses that can be well in excess of a million dollars. They can then choose to play professionally in a developmental league (aka the "minors") or go to college. The NFL and the NCAA exploits the athletes by denying them the opportunity to cash in on their potential at market values. The goal of this research is to collect data which would be used to estimate the monetary value of the NFL high school draft (if one were to exist). The student researcher will use their developing data science skills to collect data on both NFL and MLB players from many sources and to help build models to understand and interpret that data. The student should possess basic statistical skills (two courses in Statistics and one course in statistical programming preferred) and a love and interest in sports analytics. The student will work directly with Professor Wyner and his graduate students.

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Project 2: Old and Young Drivers: understanding driving behaviors of inexperienced and elderly drivers

This is a "big data" project in collaboration with the CHOP Center for Injury Research and Prevention. Multiple sensors have been placed in cars that collect video, radar and GPS information for long repeated driving epochs for a cross section of drivers. The data has been processed by a contracting collaborator. It is massive, with observations from thousands of drivers for hundreds of hours (each) collected as frequently as 10 times per second. The goal of the project is to develop statistical models to describe driver behaviors and to produce statistical descriptions and summaries that can then be used to understand the causal factors that make teens and elderly drivers so susceptible to accidents. The work is almost limitless and there will be many opportunities to publish the results. Students must have at least two semesters of statistics and one semester of statistical programming- the more the better. We will be hacking through enormous amounts of data and this project will help develop the students skills as a modern data scientist. This will be a close collaboration with Dr. Helen Loeb a researcher at CHOP.

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