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R E S E A R C H

S Y M P O S I U M 2009

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Princeton Research Symposium

Saturday, December 5, 2009

Friend Center, Princeton University

<http://www.princeton.edu/~prs>

Events of the Day

8:30am – 9:00am Breakfast

9:00am – 9:30am Opening Remarks

Sam Wang, Ph.D.
Associate Professor
Molecular Biology, Princeton Neuroscience
Institute

9:30am – 11:30am Talk Session I

11:30am – 2:15pm Poster Session and Lunch

2:15pm – 3:45pm Talk Session II

3:45pm – 4:00pm Coffee Break

4:00pm – 5:00pm Keynote Address

*Computational Design of Materials
for Energy Technologies*

Emily A. Carter, Ph.D.
Arthur W. Marks '19 Professor
Mechanical and Aerospace Engineering
Applied and Computational Mathematics

5:00pm – 6:00pm Awards and Reception

Schedule of Talk Sessions

Talk Sessions will be held in Friend 004.

Talk Session I (9:30am-11:30am)

Risk Assessment of Hurricane Storm Surge for New York City
Ning Lin, Civil and Environmental Engineering

Equal Pay for Unequal Medicine
Martin Schonger, Woodrow Wilson School/Economics

Implementing Risk-Limiting Post-Election Audits in California
Joseph Lorenzo Hall, Center for Information Technology Policy

Drawn Dress: Fashioning Digital Fabrication
Brandon Clifford, Architecture

Nature and the Making of a Scientific Community, 1869-1939
Melinda Baldwin, History of Science

Talk Session II (2:15pm – 3:45pm)

Imaging the Solar Interior
Shravan Hanasoge, Geosciences

Environmental Degradation and Out-Migration: New Evidence from Nepal
Pratikshya Bohra, Woodrow Wilson School

Running with Scissors: How Chopping Up Your DNA Can Cure Disease
Marcus Noyes, Lewis-Sigler Institute for Integrative Genomics

The Morality of Deception
Arudra Burra, Philosophy

Poster Session (11:30am -2:15pm)

Lunch will be served during the formal poster session.

All posters will be on display throughout the symposium.

Authors will be present their posters according to the following schedule:

1:30 – 12:45 PM: Odd-numbered posters

1:00-2:15 PM: Even-numbered posters

1. *Robustness of an E. coli Strain with a Defective Aminoacyl-tRNA Synthetase*
Diya Abdeljabbar, Chemical Engineering
2. *Improvements in Wireless Technology*
Vaneet Aggarwal, Electrical Engineering
3. *Progress Toward a Total Synthesis of Acutumine*
Amy Bittner, Chemistry
4. *Explaining Low mortality Among U.S. Immigrants Relative to Native-born Americans: The Role of Smoking*
Laura Blue, Program in Population Studies
5. *History of Science and Scientific Assessments of Ozone Depletion*
Keynyn Brysse, Woodrow Wilson School
6. *Development of a Double Cyclization Reaction Inspired by the Topological Complexity of Citrinadin B*
Brent Chandler, Chemistry
7. *Red Sox v. Yankees: fMRI Investigation of Pain and Pleasure Responses to a Rival Groups' Outcomes*
Mina Cikara, Psychology
8. *Habitus, or What Derek Jeter and Rosa Parks Have in Common*
David Decosimo, Religion
9. *Structure and Dynamics of the Cell Membranes*
Jun Fan, Mechanical and Aerospace Engineering

10. *Nonparametric Independence Screening in Sparse Ultra-High Dimensional Additive Models*
Yang Feng, Operations Research and Financial Engineering
11. *A Hidden Dimension to Decision Making: Animals Balance Speed, Effort and Accuracy*
Adrian de Froment, Ecology and Evolutionary Biology
12. *A Drug Delivery Device and Cell-surface Interactions for Cancer Treatments*
Guoguang Fu, Mechanical and Aerospace Engineering
13. *Understanding the Interplay Between Viruses and the Immune System During Life Long Infection*
Danna Hargett, Molecular Biology
14. *Comparing Atmospheric Measurements Taken from Space by Satellites to Atmospheric Measurements Taken in situ by Other Sensors*
Loayeh Jumbam, Civil and Environmental Engineering
15. *Quantum Cascade Lasers*
Peter Qiang Lium, Electrical Engineering
16. *Progress Towards the Total Synthesis of Maoecrystal V.*
Doug McLeod, Chemistry
17. *Evaluation of Background for the DarkSide Detector*
Pablo Mosteiro, Physics
18. *Surface Modification of Calcite to Reduce Solubility in Acid Rain*
Sonia Naidu, Chemical Engineering
19. *Gustave Eiffel and the American Wind Tunnel*
Enrique Ramirez, Architecture
20. *Simulation Studies of Coarse Grained Surfactant Models*
Samantha Sanders, Chemical Engineering
21. *Regeneration, reproduction and growth in flatworms*
Eva-Maria Schoetz, Lewis-Sigler Institute for Integrative Genomics

22. *Evidence for Developing Fractional Quantum Hall States at Even-denominator $1/2$ and $1/4$ Fillings in Asymmetric Wide Quantum Wells*
Javad Shabani, Electrical Engineering

23. *Occulter Stationkeeping for a High-contrast Imaging Mission*
Dan Sirbu, Mechanical and Aerospace Engineering

24. *Event-related fMRI During Slow Decision Making can Reveal Temporal Structure in Neural Activity*
Patrick Simen, Psychology

25. *Flux Correlation Approach to Electronic Transport through Molecular Junctions*
Maytal Toroker, Mechanical and Aerospace Engineering

26. *Reactions to Misperceptions of Ethnicity*
Matthew Trujillo, Psychology

27. *A Portrait of Forced Resettlement in Turkey*
Silvia Heidi Ullmann, Woodrow Wilson School

Opening Remarks

Professor Sam Wang, Department of Molecular Biology and the Princeton Neuroscience Institute

*Before coming to Princeton, Professor Wang studied at Caltech, Stanford, and Bell Labs, and spent a year as a AAAS legislative fellow for the United States Senate Committee. His laboratory uses optical methods to probe brain mechanisms related to movement, learning, and autism. He has received an NSF CAREER award and Young Investigator awards from the Keck Foundation and the Sloan Foundation. He also written for general audiences, including the award-winning book Welcome To Your Brain: Why You Lose Your Car Keys But Never Forget How To Drive, as well as writing for *The New York Times*, *The Washington Post*, and *USA Today*.*

Talk Session I Abstracts

Risk Assessment of Hurricane Storm Surge for New York City Ning Lin, Civil and Environmental Engineering

Hurricane storm surge presents one of the major hazards for the United States. We apply a model-based risk assessment methodology to investigate the hurricane storm surge risk for New York City (NYC). We couple a statistical and deterministic hurricane model with the hydrodynamic model SLOSH (Sea, Lake, and Overland Surges from Hurricanes) to generate a large number of synthetic surge events; the SLOSH-model simulations are validated against ADCIRC (Advanced Circulation Model) simulations. Statistical analysis on the empirical data is carried out.

It is observed that the probability distribution of hurricane surge heights at the Battery, NYC, is associated with a heavy tail, which determines the risk of New York City being struck by a catastrophic coastal-flood event. The Peaks-Over-Threshold (POT) method is applied to model the probability density function of the surge heights, with its tail represented by a Generalized Pareto Distribution (GPD). The resulting return periods of surge heights are consistent with those of other studies for the New York area. This storm surge risk assessment methodology may be applied to other coastal areas and can be extended to consider the effect of future climate change.

Ning is a doctoral student in the Department of Civil and Environmental Engineering, with a minor in the Program in Science, Technology and Environmental Policy in the Woodrow Wilson School of Public and International Affairs. She is a recipient of the Harold W. Dodds Honoric Fellowship at Princeton University.

Equal Pay for Unequal Medicine

Martin Schonger, Woodrow Wilson School/ Economics

"Equal Pay for Unequal Medicine" refers to the puzzle of patients receiving different qualities of a medical service even when, due to health coverage, paying the same amount. The two proximate causes are: across providers quality varies even when prices do not (i), and, at any given provider patients receive different quality even when paying the same price (ii). Moreover, it has been observed that patients who receive worse care are more likely to be poor or black. This empirical distribution of quality holds in other, standard markets without third party payment as well: poorer consumers tend to buy lower quality, unsurprising insofar as price varies with quality. Conditional on price though we usually expect the poor to receive quality equal to or higher than (due to price discrimination) the rich do.

Previous explanations of the disparities resort to additional assumptions like provider dislike of the poor or racism, exogenous geography, cultural misunderstandings or a conveniently signed correlation between race and patient preference for quality. This paper explains the fact pattern without such assumptions. Naturally, the theory doesn't refute any of these assumptions, but shows that even in their absence the observed patterns are to be expected, and should thus stimulate further empirical research using their observationally distinguishable predictions.

Martin is a Lecturer and Research Associate at the Woodrow Wilson School and the Department of Economics. Previously he undertook doctoral studies at Princeton and Berkeley, and graduate and undergraduate studies at the University of Bonn, Germany. He hails from Ulm, Germany. For his volunteer work in Bolivia the regional farmers' association awarded him a Medal of Honor.

Implementing Risk-Limiting Post-Election Audits in California

Joseph Lorenzo Hall, Center for Information Technology Policy

We report work designed to verify the arithmetic behind computerized voting technologies. Broadly speaking, for elections that use computerized voting machines to mark and/or count paper ballot records, a "post-election audit" compares a manual hand tally of a subset of ballots cast in randomly-selected precincts to the corresponding electronic results in those precincts. These audits are used in some form by a majority of States and serve as a check against possible software errors or fraud. A "risk-limiting" post-election audit 1) statistically limits the chance of certifying an electoral outcome if the outcome is not what a full hand count would show and 2) does this while minimizing the work of hand-counting.

In this talk, I will briefly introduce the rapidly developing field of post-election audits. I will present our work on implementing risk-limiting audits in California as well as discuss the future of such auditing methods: the ballot-based audit and the machine-assisted audit. Both of these methods involve choosing individual ballots at random

from all cast ballots and comparing a human's interpretation of their contents to the machine's recorded results.

Joseph is a joint postdoctoral fellow at the UC Berkeley School of Information and Princeton's Center for Information Technology Policy, funded by the NSF ACCURATE e-voting center. His original background is in planetary astrophysics, but has since concentrated his work in technology policy, currently emphasizing transparency policy.

Drawn Dress: Fashioning Digital Fabrication

Brandon Clifford, Architecture

For the architect, the digital era has transformed the process of design and fabrication, fueling the fire of rebellion against the standardized construction unit. Today, the architect dreams of efficient transformations, parametric constraints, and developable surfaces (a geometry capable of being made with sheet material) borrowing, oftentimes recklessly, sartorial techniques and language from the fashion industry -- darting, draping, patterning. Why then do architects contemporaries in fashion design still surround themselves with dress forms and work tables? We as architects have the opportunity to engage a similar process that has yet to take the digital leap.

Charged with the task of designing, developing, and constructing a digitally drawn dress, this comparative process serves as a catalyst to rarify architecture's contribution in the digital era. Provided with a digital body scan, the designer custom models a dress directly on the digital analog of the physical model. Once a desired silhouette is modeled, it is decomposed into developable surfaces by extracting the seam locations. In this digital world, seams need not fall in conventional locations or trace the dress form. These darts, seams, and folds are capable of manifesting any design as long as the geometric principles at play are intact. When these surfaces unroll into their 2d profiles they maintain potential energy to re-manifest as the 3d physical object, once sewn back in place. This process embraces a reciprocity between drawing and construction and by doing so pushes processes beyond the sequences found in the currently divided fields of architecture and fashion.

Brandon received a Bachelor of Science in Architecture from the Georgia Institute of Technology in 2006. During this time he also attended L'Ecole D'Architecture La Villette while apprenticing under the artist Damien Valero. He returned to Atlanta as a researcher in digital manufacturing completing the installation entitled 'A Change of State' in 2006. From 2006 - 2009 he worked for Office dA in both Boston and New York where his contributions varied in scale and program -- silverware, installations, restaurants, a professional soccer stadium, and numerous urban planning studies. In 2008 he founded 'matter design' upon being selected as a finalist in the international West Cork Arts Center competition. He is currently a master's student in the Department of Architecture.

***Nature* and the Making of a Scientific Community, 1869-1939**

Melinda Baldwin, History of Science

Although the British scientific journal *Nature* is arguably the world's most prestigious scientific publication, little has been written about its history. My dissertation is a study of *Nature* between its founding in 1869 to the beginning of the Second World War in 1939. *Nature's* founder and first editor, the astronomer Norman Lockyer, initially intended for *Nature* to reach an audience of both laymen and scientific specialists. However, *Nature's* nineteenth-century contributors found that the journal's fast turnaround time between submission and publication made it an ideal place to announce forthcoming papers or participate in scientific debates, and the magazine quickly became one written by and for scientific workers. Later, in the twentieth century, prominent physicists like Ernest Rutherford and Niels Bohr made *Nature* a major publication center for the latest work on radioactivity and atomic structures, bringing the British journal to a new international prominence. This talk will focus on *Nature* between 1919 and 1939, and in particular, on the reaction in *Nature* to the policies of the National Socialist government in Germany during the 1930s. *Nature* contributors were highly critical of Aryan racial theory and Nazi academic policies, and the journal's anti-Nazi content led the Nazi Minister for Education, Bernhard Rust, to ban the journal from German universities and libraries in 1937. The episode speaks strongly to *Nature* contributors' ideas about intellectual freedom and the appropriate relationship between science and government, and demonstrates *Nature's* growing international influence at the beginning of the Second World War.

Melinda is a fifth-year doctoral student in the Program in History of Science. She is a recipient of an Andrew W. Mellon Fellowship in Humanistic Studies and a Dissertation Research Improvement grant from the National Science Foundation. She currently holds the Porter Ogden Jacobus Fellowship from the Princeton Graduate School.

Poster Session Abstracts

1. Robustness of an E. coli Strain with a Defective Aminoacyl-tRNA Synthetase

Diya Abdeljabbar, Chemical Engineering

A recombinant methionyl-tRNA synthetase (MetRS) has been previously engineered to incorporate unnatural amino acids via site-directed mutagenesis and screening based on cell-surface display. MetRS containing a single amino acid mutation in the methionine binding pocket, leucine 13 to glycine (L13G), is very efficient at incorporating the unnatural amino acid azidonorleucine (ANL) into recombinant proteins. In addition, this mutant MetRS still retains the ability to incorporate methionine, although at a 270-fold lower enzymatic efficiency than wild-type MetRS. The gene encoding this mutant MetRS, which we term metG*, has been introduced into the genome of a methionine auxotroph replacing its wild-type gene. Due to the fact that this mutant MetRS can affect each and every protein in the proteome, the goal of this current research has been to characterize the effects of this mutant MetRS on the E. coli physiology. Growth behavior of the auxotrophic and non-auxotrophic strains has been assessed under a variety of conditions. Here we demonstrate that a single genomic copy of metG* is capable of supporting robust cell growth and enabling the high-level expression and production of recombinant proteins containing ANL. Since this mutation has been introduced into the genome, as opposed to a plasmid-borne copy, M15MA metG* is genetically stable and does not require antibiotic selection to maintain the allele. We show the effectiveness of the M15MA metG* strain in producing azide-labeled proteins for bioconjugation via click chemistry. Studying M15MA metG* may enable further fundamental investigations into the robustness of cellular protein synthesis.

Diya is a native of Union City, NJ and received a Bachelor's degree in Chemical Engineering (B.S.Ch.E.) from New Jersey Institute of Technology. He is currently a third-year doctoral student in the Department of Chemical Engineering. His Ph.D. work is focused on unnatural amino acid incorporation into proteins and organismal robustness under the guidance of Assistant Professor A. James Link.

2. Improvements in Wireless Technology

Vaneet Aggarwal, Electrical Engineering

Wireless technology has been growing rapidly in the last couple of years, thanks to the devices like the new “smart” phones and the Amazon Kindle. However, we read in the news every now and then that wireless companies such as AT&T and T-Mobile are having a hard time to meet the demands, and hence the customers are unhappy. In this poster, we consider some ways in which the performance can be improved so that the customers are more satisfied with the efficiency of wireless technology for their daily lives, and so that the growth of wireless technology continues to increase.

Vaneet received his B.Tech. degree in 2005 from the Indian Institute of Technology, Kanpur, India and his M.A. degree in 2007 from Princeton University, both in Electrical Engineering. He is currently a doctoral student in the Department of Electrical Engineering. He works with Professor Robert Calderbank. Vaneet's research interests are the applications of information and coding theory to wireless systems and quantum error correction. He received the Porter Ogden Jacobus Honorific Fellowship, the highest honor awarded by The Graduate School of Princeton University in 2009.

3. Progress Toward a Total Synthesis of Acutumine

Amy Bittner, Chemistry

Acutumine was isolated from the plant *Menispermum dauricum* DC in 1929, and its unprecedented chlorine-containing, tetracyclic alkaloid structure (including its absolute stereochemistry) was elucidated in 1967 through the application of chemical degradation and X-ray crystallographic methods. In addition to its unique architecture, acutumine has also shown various promising biological activities including: in vivo inhibition of human T cell growth and memory-enhancing properties on animal models. Starting from the parent pyrrolidine ring of acutumine, a rapid and efficient synthesis is proposed to access the framework of this complex natural molecule. Our strategy mainly relies on three key reactions: intramolecular Heck cyclization, Dieckmann condensation, and semi-pinacol rearrangement. Exceptional behaviors of carbonyl groups, which have been observed in the course of our work, will also be briefly highlighted.

Amy is a third-year doctoral student in the laboratory of Professor Erik Sorensen in the Department of Chemistry. Following the completion of her B.S./M.S. in Chemistry at Bucknell University in 2004, she worked in the Department of Medicinal Chemistry at Merck. She is currently supported by a fellowship through the Merck doctoral program.

4. Explaining Low mortality Among U.S. Immigrants Relative to Native-born Americans: The Role of Smoking

Laura Blue, Program in Population Studies

In many developed countries, immigrants live longer -- that is, have lower death rates at most or all ages -- than native-born residents. This paper tests whether different levels of smoking-related mortality can explain part of the healthy immigrant effect in the United States, and part of the related U.S. Hispanic paradox: the tendency for Hispanics to outlive non-Hispanic whites.

METHODS: With data from vital statistics and the national census, we calculate U.S. lung cancer death rates in 2000 for the foreign- and native-born populations, and for the Hispanic and non-Hispanic white populations. We then use a novel indirect estimation technique to extrapolate total smoking-related mortality for each group in that year.

FINDINGS: Smoking explains 58% of migrant's advantage in life expectancy at 50 among men, and 71% of migrant's advantage among women. Smoking explains 88% of the difference in life expectancy at 50 between U.S. Hispanic and non-Hispanic white men, and 75% of this Hispanic advantage among women.

INTERPRETATION: Low smoking-related mortality was the main reason for immigrants and Hispanics longevity advantage in the U.S. in 2000.

Laura is a second-year doctoral student in the Program in Population Studies. She works out of the Office of Population Research in Wallace Hall.

5. The History of Science and Scientific Assessments of Ozone Depletion

Keynyn Brysse, Woodrow Wilson School of Public Policy

The threat of ozone depletion by anthropogenic chlorine compounds was first recognized in 1974. Scientists realized that man-made chlorofluorocarbons (CFCs) were rising to the stratosphere, breaking down under ultraviolet (UV) radiation, and releasing chlorine. Each chlorine atom thus released could catalytically destroy thousands of ozone molecules, depleting the layer of stratospheric ozone that protects life on Earth from harmful UV rays.

In the late 1970s and early 1980s several countries produced national scientific assessments of ozone depletion. The first truly international ozone assessment came out in 1985, the same year that the Vienna Convention for the Protection of the Ozone Layer was adopted. While the Vienna Convention itself did not lead to any direct action to protect the ozone layer, it opened the doors to negotiations for the later Montreal Protocol, which did.

The Montreal Protocol of 1987 and its subsequent amendments are generally perceived as successful, and a significant measure of this success is attributed to the international scientific assessments of ozone depletion which have been produced roughly every four years, as mandated by the Protocol. Yet the early assessments missed a critical class of chemical reactions - heterogeneous or multi-phase reactions - which turned out to be responsible for the Antarctic ozone hole. The Montreal Protocol was thus based on science that was at best incomplete, at worst simply wrong; yet the ozone case is widely regarded as a successful model for science-policy interaction. What lessons can the ozone story suggest for ongoing climate change science and assessments?

Keynyn is a historian of science who normally studies the history of paleontology. Her master's thesis explored how vertebrate paleontologists responded to the theory that an asteroid killed the dinosaurs, and her doctoral dissertation examined the recent classifications of the unusual 505-million-year-old Burgess Shale fossils. She is currently working as a Postdoctoral Research Associate in the Woodrow Wilson School of Public and International Affairs. Her work there, on the history of science and scientific assessments of ozone depletion, is part of the Carbon Mitigation Initiative.

6. Development of a Double Cyclization Reaction Inspired by the Topological Complexity of Citrinadin B

Brent Chandler, Chemistry

By far the majority of chemical reactions for use in organic synthesis produce one to two bonds at a time. This circumstance reflects the intrinsic challenge of successfully executing controlled sequences of bond forming reactions. In response to the pentacyclic structure of the scarce, cytotoxic, marine-derived natural product citrinadin B, we reasoned that it might be possible to spontaneously produce three new bonds and two ring systems in a single reaction. This study outlines the utility of Seebach's nitropropenyl pivaloate (NPP) reagent for the purpose of generating cis fused bicycles.

Brent is a fourth-year doctoral student in the Department of Chemistry. Under the guidance of Professor Erik Sorensen, he is pursuing the synthesis of complex natural product targets. He has been awarded the Nat C. Robertson '42 graduate fellowship and the Hubert Alyea '24 teaching award.

7. Red Sox v. Yankees: fMRI Investigation of Pain and Pleasure Responses to a Rival Groups' Outcomes

Mina Cikara, Psychology

Because competitive groups misfortunes imply own-groups relative gain, out-groups misfortunes can engender pleasure. Pleasure at others misfortunes, Schadenfreude, may inhibit empathy towards groups in need, at best allowing indifference toward their suffering, and at worst facilitating active harm. In the current fMRI study, 10 Red Sox and 6 Yankees fans watched baseball plays featuring their favored teams and rivals playing one another and a neutral third team, the Orioles. After each play, participants reported pleasure, anger, and pain in response to the plays outcome. Favored team-success, rival-failure, and rival-failure against the neutral team (pure Schadenfreude) all elicited significantly more pleasure than the control condition (Orioles v. Blue Jays). Favored team-failure and rival-success elicited significantly more anger and pain than the control condition. Regions of the ventral striatum (i.e. putamen, nucleus accumbens) were activated by pleasurable baseball plays as compared to the control; putamen activation correlated with subjective ratings of pleasure. Also, activation in anterior cingulate cortex and insula regions (part of a well-established pain network) corresponded to painful baseball plays; insula activation correlated with subjective ratings of pain, but not anger.

These results suggest that brain systems, which also respond selectively to more basic reinforcers and punishments (e.g., juice, pain, respectively), may have adapted to integrate information about rewards as abstract as favored group-identity and positive and negative outcomes in intergroup competition. This is the first study of which we are aware to investigate the neurobiological correlates of group-identity based pleasure and pain.

Mina is a fifth-year doctoral student in the Fiske lab in the Department of Psychology. Broadly stated, she is interested in the relationship between stereotypes and peoples emotional reactions to distinct social groups. Her dissertation focuses on people's perceptions of envied targets and neural networks related to the experience of envy and Schadenfreude, or pleasure at others misfortune. Mina received the University Center for Human Values Graduate Prize Fellowship last year; she is currently participating in the Joint Degree Program in Psychology and Social Policy through the Woodrow Wilson School and is a recipient of the Charlotte Elizabeth Procter Fellowship.

8. Habitus, or What You Derek Jeter and Rosa Parks Have in Common

David Decosimo, Religion

Derek Jeter easily turns a double-play even as he dodges the oncoming runner. You spend most of the winter catching cold after cold while your roommate manages not to get sick once. The civil rights marcher presses on, knowing that fire hoses and police batons await. A grumpy economist stuck in line quickly explains why the grocery store is always crowded on Sundays.

What do these examples have in common? According to the philosopher Thomas Aquinas (1225-1274 C.E.), they all exemplify the presence and activity of habit or habitus. While habit is a common feature of our language and we all acknowledge that habits play some role in our lives, few of us give them much thought. Perhaps, we are trying to quit smoking, start exercising or something like that. Even then, we don't typically think about habits themselves. While most of us pay habits scant attention, several influential contemporary social theorists, including Marcel Mauss and Pierre Bourdieu, have argued that most of our lives and some of the most important aspects of our lives are determined by habits. This presentation is about habits, what they are and why they matter.

In particular, I explain why contemporary social theorists have ascribed habits such an important role in human life and how they have understood them. Then I turn to the Aquinas account of habits to show how it can enrich and correct current thinking about habit and help us better understand our lives and human society. I conclude by suggesting that the Aquinas account, in giving us a clearer conception of habit, can actually help us do something most of us aspire to -- to be better human beings.

David is a fifth-year doctoral student in the Department of Religion in the Religion, Ethics, and Politics subfield. His dissertation explores Thomas Aquinas's and al-Ghazali's conceptions of the moral excellences of those outside their traditions. He has been a Graduate Fellow in Religion and Culture through the Center for the Study of Religion and is currently a Graduate Prize Fellow with the University Center for Human Values.

9. Structure and Dynamics of the Cell Membranes

Jun Fan, Mechanical Engineering

Cell membranes isolate cells from outside and function as a selective sieve through which matter and information pass. Back in 1972, it was believed that the cell membrane is a uniform bilayer consisting of thousands of lipids and proteins. Afterwards, more and more experimental results suggest that the cell membrane is compositional non-uniform; it is a mixture of lipid rafts, enriched in cholesterol and sphingolipid, non-rafts matrix, and membrane proteins. Lipid rafts have been implicated in many cellular processes such as signal transduction, protein sorting and viral entry. However rafts have not been directly observed experimentally in the intact cells due to the resolution limit of the light microscopy. The formation mechanism of rafts has not been well understood either. My research is aiming to explain why rafts are so small that they could not be observed directly under microscopy in the intact cells, as well as quantify the properties of rafts, such as raft size, lifetime, and spatial distribution. In order to study cell membranes, a physical model was formulated to describe the dynamic compositional evolution of the cell membrane. This model contains two processes-- lateral diffusion on the cell membrane and vesicular trafficking to and from the membrane.

The former process result in coarsening of raft domains, and the latter one may break large raft domains into smaller ones. The simulation results suggest a fast enough trafficking process would stop rafts from coarsening and eventually induce finite size of rafts that are smaller than the microscopy resolution. This model successfully explains why the rafts are small entities. Then I quantified the properties of rafts, such as, the average size of raft domains, the raft size distribution, as well as the lifetime of the raft domains. This unique quantification method suggests a novel experimental means on studying the properties of rafts. Hopefully my work will bridge theorists and experimentalists to explore the field of cell membrane structure and dynamics together.

Jun is a fifth-year doctoral student in the Department of Mechanical and Aerospace Engineering.

10. Nonparametric Independence Screening in Sparse Ultra-High Dimensional Additive Models

Yang Feng, Operations Research and Financial Engineering

A variable screening procedure via correlation learning was proposed in Fan and Lv (2008) to reduce dimensionality in sparse ultra-high dimensional models. Even when the true model is linear, the marginal regression can be highly nonlinear. To address this issue, we further extend the correlation learning to marginal nonparametric learning. Our nonparametric independence screening is called NIS, a specific member of the sure independence screening. Several closely related variable screening procedures are proposed. Under the nonparametric additive models, it is shown that under some mild technical conditions, the proposed independence screening methods enjoy a sure screening property. The extent to which the dimensionality can be reduced by

independence screening is also explicitly quantified. As a methodological extension, an iterative nonparametric independence screening (INIS) is also proposed to enhance the finite sample performance for fitting sparse additive models. The simulation results and a real data analysis demonstrate that the proposed procedure works well with moderate sample size and large dimension and performs better than competing methods.

Yang is a fourth-year doctoral student under the supervision of Professor Jianqing Fan in the Department of Operations Research and Financial Engineering. He is currently supported by the Wallace Memorial Honorific Fellowship. He was also a recipient of the LAHA travel award by the Institute of Mathematical Statistics this year.

11. A Hidden Dimension to Decision Making: Animals Balance Speed, Effort and Accuracy

Adrian de Froment, Ecology and Evolutionary Biology

All animals need to make the best decisions possible in order to maximize their Darwinian fitness. A widespread view in biology is that animals face a simple trade-off between speed and accuracy, which they balance according to the costs and benefits involved. For example, a swarm of bees will spend less time choosing a new nest site if the cost of remaining in the open increases, at the same time accepting a higher chance of choosing a suboptimal home. However this picture ignores a third dimension to the trade-off: animals can also vary the effort per-unit-time that they invest in reducing their uncertainty about their options. This is important because the costs of time and effort can vary independently. Using a computer model, I examine whether perfectly adapted animals should make use of this to improve their decision-making. I compare individuals who can adjust both the time and the effort they invested in a decision with a second group who can adjust only the time. As the cost of time rises, the animals in the both scenarios make quicker decisions, but those in the first group also increase their level of effort, and so are able to maintain a higher level of accuracy. The model makes testable predictions about how this three-way trade-off between speed, effort and accuracy should manifest itself in nature. This will be important to researchers interested in decision-making in biology and neuroscience.

Adrian is a doctoral Student in the Department of Ecology and Evolutionary Biology, where he is a Burroughs-Wellcome Fellow studying with Professors Simon Levin and Iain Couzin. His work focuses on the decision-making strategies animals use during conflicts. In order to study conflict behavior, he uses a combination of computer modeling and observations of real fish fighting over social status.

12. A Drug Delivery Device and Cell-surface Interactions for Cancer Treatments

Guoguang Fu, Mechanical and Aerospace Engineering

My research work focuses on a novel drug delivery device and related cell-surface interactions. These include drug delivery device design and fabrication, the characterization of thermo-responsive poly (N-isopropylacrylamide) (PNIPA) based hydrogels, shear assay measurements, and cell alignment on micro-textured polydimethylsiloxane (PDMS).

A drug delivery device, with micro-channels and coated heater layer, was designed and fabricated using photolithography techniques. The device employs the thermo-responsive poly (N-isopropylacrylamide) (PNIPA) based hydrogel for controllable localized drug release. Thermo-responsive hydrogel (PNIPA) was modified to increase the lower critical solution temperature (LCST) and to improve the swelling and diffusion performance. Numerical studies showed strong concentration dependent diffusion kinetics for drug release from the hydrogel. Human osteosarcoma (HOS) cells were cultured in vitro on selected biomaterials surfaces that are relevant to implantable biomedical systems. The interfacial strengths between single cancer cells and biocompatible materials were measured under shear flow. Immuno-fluorescence staining revealed the sub-cellular adhesion between focal adhesion proteins and extracellular matrix (ECM) proteins. The spreading, alignment and integration of cells were also studied on micro-textured PDMS surfaces with systematic changes in groove height and spacing. The implications of the results were assessed for cell biophysics, and potential applications in implantable BioMEMS.

Guoguang is a sixth-year doctoral student in Department of Mechanical Aerospace Engineering. His work mainly focuses on implantable drug delivery applications and related cell-surface interactions.

13. Understanding the Interplay Between Viruses and the Immune System During Life Long Infection

Danna Hargett, Molecular Biology

Human cytomegalovirus (HCMV) infection, which occurs in over 50% of the population, can establish a dormant infection in blood cells and then reawaken and spread to different organs. Dormant infected white blood cells cross the blood vessel wall, which causes changes in their function, allowing the blood cell to make new virus and infect the surrounding tissue. During bone marrow transplantation, a weakening of the immune system fosters the reemergence of active HCMV. This can result in serious illness and even death. We developed a system for modeling the switch between dormant and active infection. Blood cells used remain similar in function to those circulating in the blood and are capable of developing a dormant infection when HCMV is introduced into the culture. Manipulation of the cell by attachment of cells and treatment with cellular signaling molecules called cytokines can cause a change in function that results in viral reawakening. Using this system, I will evaluate cellular

signaling molecules important for functional changes, the types of blood cells that harbor dormant infection, and virally expressed proteins, which influence the cellular environment. Thus, we can design better therapeutic strategies for combating infection and prevent unintentional HCMV reemergence while using existing therapies.

Danna is a Leukemia Lymphoma Society fellow in the Department of Molecular Biology in Thomas Shenk's Lab. She holds a Ph.D. in Microbiology/Immunology from the University of North Carolina at Chapel Hill, and a Master's Degree in Biotechnology from Boston University. She hails from Spartanburg, SC and is a member of the American Society for Virology. She has won several awards for her research in herpesvirology, including the G. Phillip Manire Graduate Student Excellence in Research Award Runner up, two previous fellowships from the NIH, and various travel awards.

14. Comparing Atmospheric Measurements Taken from Space by Satellites to Atmospheric Measurements Taken in situ by Other Sensors

Loayeh Jumbam, Civil and Environmental Engineering

Once a satellite is launched, its measurements need to be checked routinely throughout its lifetime to ensure that they are always valid. This is achieved by comparing the satellite readings to those of in situ sensors taken at the same time and of the same place. However, the process of comparing a satellite to in situ sensors is challenging because of the differences in the resolutions between the two types of measuring devices. My research involves addressing this problem so as to validate temperature and water vapor measurements by NASA's Atmospheric Infrared Sounder (AIRS). I make use of in situ measurements of these variables taken by the VCSEL hygrometer aboard an aircraft, for comparisons to those of AIRS. My method involves geolocating the unit measurements of both instruments that are closest in space and time, and scaling them to a reasonably comparable resolution. My results show that water vapor measurements by AIRS correlate well to those of VCSEL with an average correlation of 0.90, and temperature measurements have a correlation of 0.98. Both variables also meet their required accuracies. This study would increase confidence in AIRS temperature and water vapor measurements. It would also provide a computationally efficient method for validating other satellites.

Loayeh is a second-year master's student in the Department of Civil and Environmental Engineering working with Dr. Eric Wood.

15. Quantum Cascade Lasers

Peter Qiang Liu, Electrical Engineering

Quantum Cascade (QC) lasers are ideal mid-infrared semiconductor light sources for molecular detection in applications such as environmental sensing or medical diagnostics. For such applications, researchers have been making great efforts to improve the device performance. Recently, improvements in the wall-plug efficiency

(WPE) have been pursued to realize compact, portable, power-efficient, and/or high-power QC laser systems. However, advances were largely incremental, and especially the basic quantum design had remained unchanged for many years, with the WPE yet to reach above 35. A crucial factor in QC laser performance is the efficient transport of electrons into the laser active regions. We recently described this transport process as limited by the interface-roughness-induced detuning of resonant tunneling, but had not addressed this in actual QC lasers. Here we report that a new "ultra-strong coupling" design strategy for QC lasers successfully overcomes this limiting factor and leads to QC lasers with unprecedented 40-50 WPE.

Peter is a doctoral student in Department of Electrical Engineering. He works with Professor Gmachl on Quantum Cascade lasers and related mid-infrared technologies. Peter is a recipient of the Upton Gordon Fellowship.

16. Progress Towards the Total Synthesis of Maoecrystal V.

Doug McLeod, Chemistry

The potent and selective anticancer compound, maoecrystal V, was isolated in 2004 from the perennial herb or shrub *Isodon eriocalyx*. As an unprecedented and highly modified C₁₉ Isodon ent-kauranoid, the complex, pentacyclic topology of maoecrystal V poses a challenge to synthetic chemistry. Progress toward a concise synthesis of this natural product utilizing carbonyl-based cyclizations and a rapid development of the core structure is described.

Doug is a fourth-year doctoral student under the supervision of Professor Erik J. Sorensen in the Department of Chemistry. He is in the fourth year of a Bristol-Myers Squibb Doctoral Fellowship. Doug holds both a B.Sc.(hons) and a M.Sc. degrees in Chemistry from the University of Regina.

17. Evaluation of Background for the DarkSide Detector

Pablo Mosteiro, Physics

The DarkSide detector promises to set interesting limits on dark matter searches. To achieve this, the background level must be extremely low. The background is composed primarily of gammas from the rock in the cave and from the detector materials, muon-induced neutrons from cosmic rays, and low-energy neutrons from spontaneous fission and (alpha n) reactions in the detector materials and in the rock. We present a detailed study of these sources.

Pablo is a doctoral student in the Department of Physics, working on particle astrophysics with Professor Cristiano Galbiati. He was born and raised in Buenos Aires, Argentina and went to college at Rutgers University.

18. Surface Modification of Calcite to Reduce Solubility in Acid Rain

Sonia Naidu, Chemical Engineering

The aim of my research is to protect marble sculptures and monuments from the corrosive effects of acid rain. The approach is to coat the marble with a protective layer of lower solubility, to retard the dissolution process and preserve our works of art. We need to develop a treatment that is chemically resistant to acid attack, structurally compatible with calcite (mineral that makes up marble), involves simple chemistry and does not alter the aesthetics of the stone. For this purpose, we are currently developing a novel treatment that consists of modifying the surface of the stone by coating it with a phosphate mineral that is very durable in acidic conditions and has a similar crystal structure to calcite. Some of our preliminary work and findings in this area will be presented at the poster presentation.

Sonia is a second-year doctoral student in the Department of Chemical Engineering. She works with Professor George W. Scherer in the area of conservation of art. Her work is supported by the Kress Foundation.

19. Gustave Eiffel and the American Wind Tunnel

Enrique Ramirez, Architecture

This poster considers another aspect of work by the French engineer Gustave Eiffel (1832-1923): his work on experimental aerodynamics. From 1907 to 1914, Eiffel wrote four separate treatises, all detailing his work with airfoils, propellers, and scale-model aircraft at his aeronautical laboratories at Champ-de-Mars and Auteuil. Rather than mining the results of Eiffel's tests for their contribution to aeronautics, this paper looks to the architecture depicted in his four treatises. These works, I argue, were instrumental in bringing to the United States a building typology long-ignored in histories of architecture: the wind tunnel. The wind tunnel, I argue, represented a different kind of modernity requiring a new kind of architectural expression.

Enrique is a doctoral student in History and Theory of Architecture. His current research considers the various intersections of architecture, aviation, scientific, and military cultures in the early 20th century.

20. Simulation Studies of Coarse Grained Surfactant Models

Samantha Sanders, Chemical Engineering

Surfactants are used for a wide range of industrial applications such as detergents and oil recovery. Composed of a hydrophilic head group and a hydrophobic tail group, they self-assemble into various structures in aqueous solutions. Using atomistic models, self-assembly in dilute solutions requires significant computational resources to reach the necessary time and length scales. A recently developed group of coarse grained models provides semi-quantitative information at much higher computational efficiencies. However, coarse-grained models have not been tested for their ability to reproduce

experimentally measured critical micelle concentrations (cmc's). In this work, we analyze the ability of the MARTINI [1] and the Shinoda [2] models by obtaining molecular dynamics trajectories at multiple temperatures. Our results suggest that the models underpredict the cmc's by 1-2 orders of magnitude. We also test a method for parameterization of implicit solvent models for its ability to replicate the temperature dependence of the cmc for ionic surfactants [3]. In this method, the hydrophobic interaction is concentrated on the terminal tail bead. From the created implicit solvent models, we are able to see an approximation of the minimum of the cmc with respect to temperature. Both types of models are successful in overcoming computational limitations of atomistic simulations. However, additional work is needed for their refinement in order to create quantitative, transferrable models for surfactant self-assembly.

[1] Marrink, Risselada, Yefimov, Tieleman, and de Vries, *J. Phys. Chem. B* 111, 27 (2007).

[2] Shinoda, Devane, and Klein, *Mol. Sim.* 33, 27 (2007)

[3] Jusufi, Hynninen, and Panagiotopoulos, *J. Phys. Chem. B* 112, 13783 (2008).

Samantha is a fourth-year doctoral student in the Department of Chemical Engineering advised by Professor A.Z. Panagiotopoulos. She was a recipient of the National Defense Science and Engineering Graduate Fellowship. She is originally from Indiana and received her Bachelor's degree in Chemical Engineering from Purdue University.

21. Regeneration, reproduction and growth in flatworms

Eva-Maria Schoetz, Lewis-Sigler Institute for Integrative Genomics

Planarians (flatworms) are one of the simplest bilaterally symmetric organisms and famous for their extraordinary regenerative capabilities. One can cut a worm in 100 pieces and after a few weeks one obtains 100 new worms that have reconstructed their entire body, including a central nervous system. This amazing regenerative capability is due to a population of stem cells distributed throughout the planarian body. The presence of these stem cells does not only allow the worms to heal without scarring after wounding, it also allows for asexual reproduction: Planarians can split themselves in two, and then regenerate the missing body parts within about a week.

We are interested in the forces that govern asexual reproduction, the differences between regeneration after reproduction vs. wounding, and the dynamics of population growth under different environmental conditions. I will give an introduction to the biology of this fascinating organism and explain our current understanding of the influence of various environmental factors on reproduction.

Surprisingly, we found that reproduction decreases with increasing food supply, opposite to the relationship between food and reproduction found in other asexually reproducing organisms, and causing obese worms. This result, and the fact that planarian genes have a high similarity to human genes, suggests that planarians could serve as a model organism for the study of obesity in humans. We are further testing

quantitatively whether these worms are truly "forever young" as implied by their totipotent stem cell population that can replace all damaged or aging tissue.

Eva-Maria is a Lewis-Sigler Fellow at the institute for Integrative Genomics and a Lecturer in the Department of Physics since October 2007. She received her Ph.D. in Biophysics at the MPI for the Physics of Complex Systems and the MPI for Cell Biology and Genetics, Dresden, Germany.

22. Evidence for Developing Fractional Quantum Hall States at Even-denominator $1/2$ and $1/4$ Fillings in Asymmetric Wide Quantum Wells

Javad Shabani, Electrical Engineering

The integer quantum Hall effect was discovered about one hundred years after Hall's original work. It was found that under certain conditions in a two-dimensional electron system subjected to low temperatures and strong magnetic field, the Hall conductivity is quantized. The fractional quantum Hall effect observed two years after turned out to have drastically different underlying physics.

Two-dimensional electron system behaves as if it were composed of particles with fractional charges. Each particular value of the magnetic field where the Hall conductivity is quantized, corresponds to a filling factor (the ratio of electrons to magnetic flux quanta) which can be written as $\nu = p / q$ where p and q are integers with no common factors and q turns out to be an odd number. In recent years exceptions have been found where q is an even number. Numerous theoretical studies have been shown that these even denominator fillings could possibly have particles with special excitations (non-abelian) which will make these states suitable for realization of topological quantum computation. We present observation of developing fractional quantum Hall states at filling factors $\nu = 1/2$ and $1/4$. We find that these states are beyond our conventional fractional quantum Hall understanding and together with the fact that they disappear when we make the wave-function symmetric, it suggests that these states could possibly possess non-abelian statistics.

Javad is a fifth-year doctoral student in the Department of Electrical Engineering. His thesis advisor is Mansour Shayegan.

23. Occulter Stationkeeping for a High-contrast Imaging Mission

Dan Sirbu, Mechanical Engineering

One of the most promising methods for the direct detection of planets around neighboring solar systems is to use an occulter aligned with the observing space telescope and the target star in order to block the incoming starlight and render the orbiting planet visible. Here we are interested in the formation-keeping problem of an actively controlled occulter spacecraft in relation to the telescope, which is set to be flying on a ballistic halo orbit about the Sun-Earth L2 point. We model the nonlinearities present in this microgravity environment as a three-body problem that

features the Sun and the Earth as the primary bodies and each spacecraft is the mass-negligible third body. A co-rotating frame of reference aligned with the primaries allows for the alignment of the body frames of the telescope and occulter. Here we have implemented and simulated a position control algorithm that relies on observations of the position of the telescope from measurements from the deep space network and of the occulter relative to the telescope using a pupil-plane stationkeeping camera that measures leakage around the occulter outside of the science passband. Disturbing effects in this simulation include solar radiation pressure and fourth body effects due to the moon.

Dan was awarded a B.Sc. in Electrical Engineering from the University of Alberta, Canada, in 2008. He is currently a doctoral student in the Department of Mechanical and Aerospace Engineering, and holds a Gordon Wu fellowship and an NSERC Postgraduate scholarship.

24. Event-related fMRI During Slow Decision Making Can Reveal Temporal Structure in Neural Activity

Patrick Simen, Psychology

Because of the brains sluggish blood-flow response to neural activity, the temporal profile of activity underlying rapid cognitive processes is difficult to infer with functional magnetic resonance imaging (fMRI). To address this problem, we have developed an experimental design for behavioral decision-making research that successfully slows human response times into the 5-10 second range. In this range, different temporal profiles of neural activity over the course of individual decisions are distinguishable on the basis of the brains predicted hemodynamic response. We induce behavioral slowing by paying participants for correct responses and imposing stiff monetary penalties for errors in a two-alternative, dot-motion discrimination task. Previous theoretical analysis of optimal performance in such tasks predicted that penalties would induce participants to use the same procedure for decision making as when responses are rapid, but to adopt conservative response criteria that favor more accurate, slower performance. Using this penalty-based experimental design with fMRI, we have obtained evidence that neural activity in motor planning areas ramps up nearly linearly over the course of a single decision. This evidence is consistent with a model of simple decision-making in which neurons at intermediate stages between sensory and motor areas implement a random walk to produce decisions.

Patrick is a postdoctoral fellow in the Princeton Neuroscience Institute (PNI), working with Jonathan Cohen (PNI/Psychology) and Philip Holmes (PNI/MAE/PACM). He is funded by a research training fellowship from the National Institute of Mental Health to study decision making using functional magnetic resonance imaging (fMRI) and electroencephalography (EEG). He comes from Flint, Michigan and has Bachelor's degrees in Math and Philosophy from Brown University and a Ph.D. in computer science from the University of Michigan.

25. Flux Correlation Approach to Electronic Transport through Molecular Junctions

Maytal Toroker, Mechanical Engineering

The conventional approach for calculating current through a molecular junction is the Landauer formalism, which considers the transmission along a single electronic scattering coordinate. Calculation of the transmission may be computationally impractical since it requires the use of the Greens operator. Moreover, the computation must be repeated for all energies of an incoming electron. As opposed to the energy dependent approach, an alternative time-dependent method is suggested for calculating current through a molecule. A flux-flux correlation function formulation is derived exactly from Landauer formula. The flux-flux correlation function technique is borrowed from the field of chemical reaction rates, where here the initial ensemble is a Fermi-Dirac thermal population of electrons in the source electrode rather than a Boltzmann distribution of reactants in a chemical reaction. A time dependent approach is a natural choice for a rate process, which adds an intuitive perspective by monitoring the dynamics of evolving states. In addition, practical advantages and implementations have been developed for flux correlation functions, such as the flux averaging method. Furthermore, information on the electrodes bandwidth can be extracted directly from the correlation functions oscillations if the time scale of the decay rate of molecular resonances is much smaller than the time scale of hopping between sites in an electrode. The methodology will be demonstrated on the tight binding model, which is commonly used in the field of molecular electronics.

Maytal is a Postdoctoral Research Fellow in the Department of Mechanical and Aerospace Engineering. She previously held the Sara Lee Schupf Weitzmann Institute Fellowship and the New England Fund Technion Fellowship. The research presented was done during the Ph.D. under the supervision of Assoc. Prof. Uri Peskin, the Schulich Faculty of Chemistry at the Lise Meitner Center for Computational Quantum Chemistry, Technion Israel Institute of Technology, Haifa 32000, Israel.

26. Reactions to Misperceptions of Ethnicity

Matthew Trujillo, Psychology

I conducted research investigating the phenomenon of ethnic miscategorization, the process of having ones ethnicity incorrectly categorized by another. For example, when a Chinese American is miscategorized as being Japanese.

I conducted three studies on ethnic miscategorization. Study 1 was a survey that found that Asians, Latinos, and multi-ethnics experience ethnic miscategorization at a frequent rate and that this experience elicits negative effects. Studies 2 and 3 were experiments, online and laboratory respectively, that tested the effect of ethnic miscategorization on identity asserting behavior. Participants in study 2 were presented with one of three different newspaper article primes: ethnic miscategorization is pervasive in society, ethnic miscategorization is rare in society, or plagiarism is pervasive in society. After being presented with the primes, participants rated their

preference for products associated with their self-categorized ethnic group, a similar ethnic out-group (one they would likely be miscategorized as being a member of), and neutral products not associated with a similar ethnic group.

Results from this study indicate that Asians primed with the idea that ethnic miscategorization is pervasive expressed less liking for in-group products compared both to neutral products and to the control conditions. Study 3 involved a manipulation where participants were either ethnically miscategorized or correctly categorized by an interaction partner. Findings from this study replicated the results from study 2. In addition, results from study 3 show that the participant's level of ethnic centrality, how central a person's ethnicity is to their self-concept, moderates the relationship between ethnic miscategorization and identity assertion.

Matt is a doctoral student in the Joint Degree Program of Psychology and Social Policy. He conducts research on ethnic identity and prejudice with Nicole Shelton and Joel Cooper. He is originally from Phoenix and attended Arizona State University as an undergraduate.

27. A Portrait of Forced Resettlement in Turkey

Silvia Heidi Ullmann, Woodrow Wilson School

Migration caused by large-scale industrial projects is an increasingly important aspect of development studies. In some cases, migrants may be drawn into an area in anticipation of increased employment opportunities that the construction and/or operation of a new project will generate. At the same time, many development projects require the resettlement of entire communities from their homes and land. The aim of my investigation is to carry out an exploratory study examining forced resettlement as a consequence of dam construction in Turkey. First I describe the current state of dam construction in Turkey, focusing on the potential health and social impacts on the surrounding communities. In order to contextualize the resettlement process in Turkey, the second part of my project consists of a case study of the village of Tayfur Sokmen, a community located in the Antakya province of Turkey, near the Syrian border, that was displaced due to a dam project in the Black Sea region.

Contextualizing the resettlement process through the use of case studies allows those who have experienced resettlement directly to have a voice, and it is beneficial because it enhances our understanding of this very complex process. By including their experiences, this investigation moves beyond analyses that consider macro-level factors exclusively, or those that examine resettlement from the governments and planning agencies point of view.

Heidi is a third-year doctoral student in the Woodrow Wilson School and the Office of Population Research. She holds a B.A. in Latin American Studies from Barnard College and an MPH in Population and Family Health from the Mailman School of Public Health at Columbia University. Prior to coming to Princeton she was involved in a number of research projects, both domestically and abroad, related to women's health

and migration. Her current research interests include the relationship between health and development, infectious disease epidemiology, and international health policy.

Talk Session II Abstracts

Imaging the solar interior

Shravan Hanasoge, Geosciences

The Sun is a most remarkable object: it is filled with vibrantly evolving magnetic fields, well-mixed hierarchically-arranged turbulent convective cells, and poorly-mixed sunspots that persist with impunity.

For theorists, the Sun poses many challenges: a large number of solar magnetic processes, both sub-surface and atmospheric, remain tantalizingly beyond the grasp of current theoretical methodology. However, it has never been clearer that in deconstructing these phenomena, we may find the connecting threads to many structural and dynamical events in the universe at large.

While the interior layers of the Sun are optically invisible, they are well traversed by acoustic waves that propagate in the interior and return to the surface. Akin to geoseismology, the structure of the dynamics of the solar sub-surface may be inferred from studying the surface manifestation of these oscillations. Over the last 13 years, a highly spatially resolved image of the solar surface velocity field has been measured once every minute by a number of instruments. These near-continuous observations allow us to image the interior of our main-sequence neighbour with unprecedented accuracy and precision.

At present, we are attempting to extend an avant-garde 3D imaging technique in geoseismology, termed the adjoint method, to the solar situation. This interdisciplinary work lies at the boundary between helioseismology, stellar physics, geophysics, computational methods, and inverse theory. In this talk, I will discuss the significance of pursuing an understanding of the Sun and solar magnetic activity, the state of art in helioseismology, and the adjoint method as applied to the Sun.

Shravan is a visiting postdoctoral scholar at the Department of Geosciences and an associate fellow at the Princeton Center for Theoretical Science. He obtained his Ph.D. at Stanford University in 2007 in the area of numerical helioseismology. Shravan is actively interested in dynamo theory and the study of the evolution of large-scale magnetic fields in the universe.

Environmental Degradation and Out-Migration: New Evidence from Nepal

Pratikshya Bohra, Woodrow Wilson School

Although the concept of environmental refugees was introduced in the mid-1980s and remains quite popular in many quarters, there is relatively little empirical work demonstrating the existence and nature of a connection between environmental change and human migration. In this study we contribute to this literature by updating and expanding on recent work done in Nepal using data from the Chitwan Valley Family

Study. We use event history data to model local, internal, and international migration as a function of environmental deterioration at baseline while controlling for social, economic, and demographic variables that prior work has shown to affect population mobility.

We find a strong and consistent relationship between the likelihood of undertaking a local move and population pressure (measured by neighborhood density), deforestation (indicated by rising times required to collect fodder and firewood), and declining agricultural productivity. We also find that the environmental effects on local migration are more prevalent for women than for men. We found little evidence that environmental deterioration promoted migration outside of the local district, either to other districts in Nepal or to international destinations, though increased time to collect firewood was associated with a higher probability of men leaving Chitwan for other countries or other districts in Nepal. In general, our results suggest that the kind of gradual environmental deterioration studied here is more associated with local than distant population mobility.

Pratikshya is a fourth-year doctoral student at the Woodrow Wilson School and the Office of Population Research. She holds a B.A in Economics from Union College in Upstate New York. Her research interests include migration, remittance and development, immigrant assimilation, and racial and economic inequality.

Running With Scissors: How Chopping Up Your DNA Can Cure Disease

Marcus Noyes, Lewis-Sigler Institute for Integrative Genomics

Countless diseases are caused by a mutation in the DNA coding sequence of a gene. Genes act as the blueprint for constructing proteins, the molecules that perform the real work in our cells. Mutated genes lead to dysfunctional proteins and consequently, the harmful effects that cause the disease. In a few model organisms such as mice and yeast, mutations can be corrected by a mechanism called homologous recombination, which essentially cuts and pastes a correct version of the gene into the DNA. Unfortunately, this mechanism functions at such a low frequency in human cells that it is not possible to use such an approach to cure human diseases.

However, it has been shown that cutting DNA at the precise desired point of change will greatly increase the frequency of homologous recombination and therefore make this approach feasible. The remaining limitation is the ability to target the cut to the exact desired location without harming the rest of the DNA. To this end, zinc finger nucleases are used to target these cuts in DNA. Zinc fingers are extensively engineered protein domains designed to interact with desired DNA sequences while the attached nuclease cleaves the adjacent DNA. Thus far, engineering of these domains has been limited to the targeting of certain types of DNA sequences and has produced unacceptable levels of off-target cutting for human therapeutics. The Noyes Lab focuses on enhancing the targeting precision of these molecular scissors in order to realize the full potential of gene therapy and the eradication of genetic diseases.

Marcus joined the Lewis-Sigler Institute for Integrative Genomics as a Lewis-Sigler Fellow in the summer of 2009. He earned his Ph.D. from the University of Massachusetts Medical School, where his work on transcription factor DNA-binding specificity was recognized by the University with an Outstanding Thesis Research Award. Dr. Noyes was also a 2009 recipient of the Harold M. Weintraub Graduate Student Award from the Fred Hutchinson Cancer Research Center, Seattle, WA. Dr. Noyes resides in Princeton, NJ with his wife, Tania, and is originally from Blaine, Minnesota.

The Morality of Deception

Arudra Burra, Philosophy

It seems wrong to lie to others, except in certain special circumstances: for instance, if it is only by lying that we can prevent a very great harm to someone.

But some times it doesn't seem wrong to lie at all: if I misrepresent what I am willing to pay for a used car, or if I lie to you in a game of bluff, or if I am a spy and you work for the enemy. But how could that be? What special circumstances obtain in these cases that make it permissible to lie?

These questions point towards some interesting features about the structure of the moral principles that govern deception (as well as other things). There are close connections between these issues and issues in the philosophy of science concerning the nature of scientific laws. I will try and say something about this connection.

Arudra Burra is a fifth-year doctoral student in the Department of Philosophy, writing a dissertation on the concepts of exploitation, coercion, and consent. He also holds a J.D. from the Yale Law School. He is a Graduate Fellow at the Fellowship of Woodrow Wilson Scholars, and has been a Graduate Prize Fellow at the University Center for Human Values.

Keynote Address

Computational Design of Materials for Energy Technologies

Professor Emily Ann Carter, Department of Mechanical and Aerospace Engineering and Program in Applied and Computational Mathematics

Many solutions are being proposed to the energy and climate crises that threaten to engulf our planet. Energy and climate issues are tightly intertwined via fossil fuel combustion, which puts CO₂ into the atmosphere, ultimately contributing to global warming. Likewise, energy demands will ultimately force the costs of fossil fuels up to unprecedented levels. Research that leads to revolutionary ways to generate electricity and liquid fuels, as well as to improve energy efficiency, is sorely needed. If such new technologies arise, the twin problems of energy demand and global warming will be addressed simultaneously. Many of the roadblocks to progress are related to the lack of optimal materials to accomplish the task. This talk introduces the topic of how quantum mechanics based computer simulation tools are being harnessed to address materials science problems related to generating and storing electricity (via gas turbines, the sun, and fusion) and reducing vehicle weight to improve fuel efficiency.

Professor Carter is a theorist first known for her work combining ab initio quantum chemistry with dynamics and kinetics, especially as applied to surface chemistry. For the last decade or so, her applications focus has been to determine how materials fail due to chemical and mechanical effects (e.g., corrosion and stress), and how to optimally protect these materials against failure (e.g., by doping, alloying, or coating). At present, she is turning her attention toward molecular and materials design for energy applications, including exploring novel materials for solar energy conversion to electricity and fuels, characterizing combustion chemistry of biofuels, and optimizing lightweight metal alloys to improve vehicle fuel efficiency.

She received her B.S. degree in Chemistry from UC Berkeley in 1982 (graduating Phi Beta Kappa) and her Ph.D. in Chemistry from Caltech in 1987. After working as a Postdoctoral Research Fellow at the University of Colorado, Boulder for a year, she spent the next 16 years on the faculty of UCLA as a Professor of Chemistry and later also of Materials Science and Engineering. She moved to Princeton University in 2004 as Professor of Mechanical and Aerospace Engineering and Applied and Computational Mathematics and was named Arthur W. Marks '19 Professor in 2006. She also holds courtesy appointments in Chemistry, Chemical Engineering, and two interdisciplinary institutes (PICSciE and PRISM).

You can learn more about her at <http://carter.princeton.edu>.

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