Project Title: Disseminating Computational Modeling in the Social Sciences

Project Number: 0433086

HSD Emphasis Area: Dynamics of Human Behavior

Lead PI: James A. Kitts, Columbia University
Co-PIs: Martina Morris, University of Washingto and Michael W. Macy, Cornell University
Collaborators: Tanzeem Choudhury, Intel Research, Dartmouth College

Project Goals:
The social world that we observe reflects a web of interdependent processes, with macro-level structures of organizations, communities, and societies both emerging from and constraining the micro-level interactions of individuals. Most social science research has focused on finding statistical relationships in cross-sectional data – such as correlations of individuals' age with political attitudes, the demographic composition of personnel with organizational performance, or law enforcement policies with municipal crime rates – while assuming that the objects of study are independent. This focus may describe typical static patterns, but gives us limited insight into the underlying generative processes or the dynamic consequences of statistical relationships. Furthermore, many social phenomena are inherently time varying and depend on interactions among entities within a social system, such as in the spread of epidemics, the rise of political insurgency, or the dissolution of formal organizations.

Understanding the link between micro-level interactions and macro-level dynamics could have profound impact on the ways we engage basic social science research. Toward this end, an increasing number of scientists are using computational models to elucidate theoretical problems in social dynamics, often by applying general theories or methods from the natural sciences. For example, models from statistical physics have been used to study healthcare organizations, population ecology models have been applied to the study of the evolution of industries, and neural networks have been used to model the origins of religious beliefs.

Although these links are promising, their impact is limited by conventional disciplinary institutions that fail to promote broad diffusion of ideas and methods. Within the social sciences, the audience for computational modeling remains largely confined to a small community of modelers. Although a handful of interdisciplinary centers advance these tools, few disciplinary social science programs currently offer training in computational modeling. Most B.A. and Ph.D. students graduate without learning to be critical consumers of research using these innovative tools, let alone use the tools in their own research. Unsurprisingly, most social science journals have poorly-developed standards for evaluating research employing computational models. This project aims to make research in social dynamics both more rigorous and more accessible by offering training resources in computational modeling and by facilitating exchanges of models and methods among scholars from a variety of disciplines.

Project Progress for 2007-2008:
An important focus of our efforts in the fourth year of the project has been the advancement and refinement of computational modeling among established researchers, including resources for faculty development and retraining. The investigators and graduate students working under this grant are publishing research papers that exemplify some best practices in computational modeling of social dynamics. (One of the PI's articles won the American Sociological Association's 2007 Best Paper award in Mathematical Sociology and his graduate student research assistant won the corresponding Best Graduate Student Paper award for a different paper.) The project supported five articles in computational modeling this year:

- Kitts, James A. and Paul T. Trowbridge. "Shape Up Or Ship Out: Social Networks, Social Influence, and Organizational Demography." – *Computational and Mathematical Organization Theory,* 13(4): 333-353, December 2007.

- Kitts, James A. "Dynamics and Stability of Collective Action Norms." *Journal of Mathematical Sociology,* 32(2): 1-22, April 2008.
- Chiang, Yen-Sheng. "A Path Toward Fairness." *Rationality and Society,* 20(2): 173-201, 2008.
- Lin, Zhiang, Kitts, James A., Yang, Haibin, and J. Richard Harrison. "Elucidating Strategic Networks Through Computational Modeling." *Computational and Mathematical Organization Theory*, In Press (2008).
- Goodreau, Steven, Kitts, James A., and Martina Morris. "Birds of a Feather or Friend of a Friend? Using Exponential Random Graph Models to Investigate Adolescent Friendship Networks." – *Demography*, 45(4): In Press (2008).

The PI continued to offer his seminar on computational modeling of social dynamics, presenting at the Japan-North America Conference on Mathematical Sociology and at the Division of Management at Columbia University. He also participated in an expert panel on computational modeling of organizational behavior at the annual meeting of the Academy of Management in August, 2008, and was elected to the council of the Mathematical Sociology section of the ASA. Outreach continues as investigators gather materials from scholars and teachers for dissemination through the project web page (URL below). The interdisciplinary workshop report is available at the URL below.

Broader Impacts:
In developing and disseminating materials for learning and curricular reform, we aimed to improve training in dynamics within traditional social science disciplines. This year we have moved beyond formal learning contexts, offering an interdisciplinary workshop report and seminars at professional meetings to assist faculty in integrating dynamic modeling into their own research programs. All of these efforts aim to increase the prominence and integrity of dynamic modeling practices in the social sciences, ultimately enriching our understanding of social dynamics.

Project Website: http://www.columbia.edu/~jak2190/dynamics.html
Workshop Website: http://seattle.intel-research.net/MSD/

Project Title: International Integrated Microdata Series

Proposal Number: 0433654

HSD Emphasis Area: Dynamics of Human Behavior

Lead PI: Steven Ruggles, University of Minnesota
Co-PIs: Dennis Ahlberg, Ragui Assaad, Deborah Levison, Robert McCaa, Matthew Sobek

International Partners: Over 80 national and international organizations are collaborating on this project; a list is available at https://international.ipums.org/international/international_partners.html

Project Goals:

- The first goal is to collect and preserve as much as we can of the world's census data. Census data are collected at great cost, but they are often difficult for researchers to access. In many countries the older data are at risk of destruction as technologies and personnel change.
- The second goal is to harmonize the data to enhance their utility. The project does much more than just archive the data: it translates all documentation into English, fully documents comparability issues regarding census questions, and codes the data consistently across samples to facilitate international comparisons. The original unaltered data is also preserved and stored redundantly.
- The third goal is to disseminate the data. An interactive data system lets users select only the variables and censuses that they need for their research. To help users manage the vast quantity of information, the web dissemination system filters the documentation to display only the censuses that users specify. The data and web system are available to qualified researchers anywhere in the world completely free of charge.
- The final goal is to protect confidentiality. A series of steps are taken to ensure that it is impossible to identify individuals in the data. The countries that supply their data to the project must have absolute confidence that privacy is being protected, since that is a nearly universal promise governments make to their citizens when they take a census.

Thematic Areas:

- Data infrastructure.
- Human population.
- International comparative research.

Methodologies:

- Data integration. The hardest part of data integration is managing the metadata. Variables common across censuses are consistently recoded using a metadata-driven C++ program. Project researchers manipulate relatively simple documents in common document formats. These are exported to a structured XML markup system that defines the integration process.
- Data extraction. The web-based data extraction system is driven by the same metadata that direct the integration process, so the two can never be out of sync, even as the project continues to evolve. The web system allows users to browse the thousands of variables while employing sample filters to winnow the amount of information to manageable levels. The extract process itself is a step-by-step wizard designed to constrain the scope of decision-making required at each stage.
- Confidentialization. Data come to the project in a variety of states. Developing countries often provide full data detail except street address and name. We draw samples from the data, suppress low-level geography, top-code sensitive continuous variables like income, and suppress small categories that represent very few persons in the population. We also randomly reassign a small number of cases between geographic areas to ensure that a

unique case cannot be definitively said to come from a specific locality. The user registration license provides a final, institutional protection.

Recent Research Findings:
During the past year—the fourth of the project—we added samples for 32 censuses from 14 countries to what was already the world's largest collection of census microdata. The project now distributes the individual records of 263 million persons from 111 censuses of 35 countries taken since the 1960s. Over 2000 researchers around the world have registered to use the data.

This year we entirely redesigned the web data dissemination system. The old system would no longer scale as the project broke the 100-sample barrier with over 12,000 variables. The new system offers a variety of ways of viewing and filtering the information, and it lets researchers earmark variables for data extraction from anywhere within the system.

The sheer size of the datasets has been one of the greatest barriers to use—especially for researchers in developing countries. Although the system allows researchers to select on the variables and samples they need, the data extracts could still reach many gigabytes in size. Accordingly, this year we introduced a feature that lets researchers define their desired extract size for each sample. The extract system draws out the appropriate number of cases and adjusts the weights to reflect the altered sample densities.

Challenges and Opportunities:
The size of the data collection poses ongoing challenges. We must continue to innovate in our web development to keep the information from overwhelming users. It is a continuing and growing challenge to make users aware of the many design and comparability issues inherent in international comparative research. We also need to develop improved strategies of data storage and extraction on the back end of the system, so that user requests for data can be as fast as possible.

To keep the database as policy-relevant as possible, we need to acquire as many samples from the upcoming 2010 round of censuses as possible. We hope to build on our past success and archive many full-count datasets, even in instances when we only distribute samples. We also expect to continue expanding the geographic scope of the data series in Africa and Asia in particular. In any case, it will be a significant challenge to process all of the data that we expect to receive in the next several years while continuing to work down the backlog of material we've already archived.

Many countries have entrusted us with 100 percent of their national data. We only deliver samples publicly (typically one to ten percent), but we hope to develop a data enclave at Minnesota where visiting researchers could analyze the full-count data under strict controls. There could be many interesting future methodological developments down this road.

Project Title: Children and Technology Project

Proposal Number: 0527064

HSD Emphasis Area: Dynamics of Human Behavior

Lead PI: Linda A. Jackson, Michigan State University
Co-PIs: Yong Zhao, Alexander von Eye, Hiram Fitzgerald, Rena Harold
Collaborators: 20 middle schools in the lower peninsula of Michigan and one after-school program in Detroit, Michigan. See Participants listed on the project website: http://www.msu.edu/user/jackso67/CT/children/

Project Goals:

- To describe children's information technology (IT) use and the socio-demographic characteristics related to IT use.
- To describe the relationship between children's ITuse and their cognitive, social, psychological and moral development.
- To provide directions for future research and public policy regarding children and IT use.

Thematic Areas:

- Developmental psychology
- Technology use
- Human-computer interaction

Methodologies:

- Surveys
- Standardized testing

Recent Research Findings:
Findings are reflected in publications in professional journals and presentations at professional conferences. Note that these and a number of forthcoming submissions are all based on Wave 1 data. There will be 6 waves of data by June 2009.

Referred Professional Journals:
Jackson, L. A., Zhao, Y., Kolenic, A., Fitzgerald, H. E., Harold, R., & von Eye, A. (2008) Race, gender and Information Technology use: The new digital divide. *CyberPsychology and Behavior*, 11, 1-6
Jackson, L. A., Zhao, Y., Qiu, W., Kolenic, A., Fitzgerald, H. E., Harold, R., & von Eye, A. (in press). Cultural differences in morality in the real and virtual worlds: A comparison of Chinese and U.S. youth. *Cyberpsychology and Behavior*.
Jackson, L. A., Zhao, Y., Kolenic, A., Fitzgerald, H. E., von Eye, A., & Harold, R. (in press) Information technology use and children's psychological well-being. *Cyberpsychology and Behavior.*
Jackson, L. A., Zhao, Y., Qiu, W., Kolenic, A., Fitzgerald, H. E., Harold, R., & von Eye, A. (in press). Culture, gender and information technology use: A comparison of Chinese and U.S. youth. *Computers in Human Behavior*.
Jackson, L. A., Fitzgerald, H. E., von eye, A., Zhao, Y.& Witt, E. A. (invited chapter). The digital divides in the U.S.: Access, broadband, and nature of Internet use. To appear in E. Ferro, E., Dwivedi, Y. K., Gil-Garcia, J. R., & Williams, M. D. (Eds.). *Overcoming the digital divides: Constructing an equitable and competitive information society.* (submitted June 2008).
Jackson, L. A., Zhao, Y., Kolenic, A., Fitzgerald, H. E., von Eye, A., & Harold, R. Self-concept, self-esteem, gender, race and information technology use. *Journal of Early Adolescence*. (submitted July 2008).

Jackson, L. A., Zhao, Y., Kolenic, A., Fitzgerald, H. E., von Eye, A., & Harold, R. Gender, race and morality in the virtual world and its relationship to morality in the real world. *Journal of Applied Social Psychology*. (submitted March 2008).
Jackson, L. A., von Eye, A., Fitzgerald, H. E., Zhao, Y. & Witt, E. A.. IT use and academic performance: A longitudinal study of the impact of gender, race, income and IT use on 12 year olds' grades in school, GPAs and standardized test scores in reading, mathematics, and spatial skills. *Developmental Psychology*. (submitted September 2008).

Presentations:
Jackson, L.A., Zhao, Y., Qiu, W., & Kolenic, A. (2008). Morality in cyberspace: A comparison of Chinese and US youth's beliefs about acceptable online behavior. *Proceedings of the Hawaii International Conference on System Sciences*, Waikoloa, Big Island, Hawaii, January 7-10, 2008.
Shifflet Gibson, E., Ahmedani, B. K., Fitton, V., Harold, R. D., & Coraci, V.(2008, May). Wired kids: Information on adolescent technology use for social workers. Paper presented at the NASW-MI Chapter 2008 Annual Conference. Lansing, MI.

Challenges and Opportunities:
Managing a large, longitudinal data set to address both the issues raised in the original proposal and additional issues that are emerging as we explore the data. This is both a challenge and an opportunity.

Project Title: AOC: Globalization and Offshore Sourcing of Knowledge Work

Proposal Number: 0527180

HSD Emphasis Area: Agents of Change

Lead PI: Kenneth L. Kraemer, UC Irvine
Co-PIs: Jason Dedrick, Gloria Mark and David Brownstone, UC Irvine and Erran Carmel, American University

Research Goals:

1. Understand the factors shaping firm decisions to offshore knowledge activities.
2. Identify the impacts of offshoring for firm performance.
3. Assess the broader societal implications of offshoring for trade, economic growth and employment.

Thematic Areas:

1. Globalization of new product development (NPD) in electronics hardware and of software development.
2. Relative importance of economic and relational factors and ICT in offshoring decisions.
3. Impacts on firm performance

Methodologies:

Field interviews with US multinational firms in the computer hardware and software sector, case studies of these firms, interviews with offshore firms providing development services, national survey of 400 firms in electronics manufacturing and software development.

Recent Research Findings:

Our earlier findings were as follows:

1. Our key finding in 2006 was that offshoring of manufacturing in the notebook PC industry was pulling more routine knowledge work in NPD offshore. In 2007, we found that it is also pulling higher-value design activities and even some R&D offshore as well, although those are driven mainly by cost and availability of skilled scientists and engineers, or by the need to be close to customers that have moved offshore. We found in 2007 that Taiwanese original design manufacturers, who are responsible for development of notebooks, motherboards and other products for U.S. vendors, have stopped shifting high-end development work to China. Instead they keep this work in Taiwan and do prototyping, testing and process engineering in China.
2. The findings about manufacturing were reinforced by new findings in 2007 about software development. Production work such as software coding and testing is now pulling some design work offshore. The result is that often only the system requirements, architecture, and implementation activities remain on shore. In some cases, entire projects are being taken over by offshore teams rather than divide the work between onshore and offshore teams.
3. Proximity requirements are a key underlying factor that affects location, but operates differently for hardware than for software. For hardware, proximity tends to pull other activities offshore whereas for software, proximity so far tends to keep activities onshore.

   For hardware, proximity requirements are dictated by the fact that so much manufacturing has been outsourced and moved offshore. In turn, the supply base and supporting resources for rapid innovation (e.g., machine shops, tooling, board designers) have clustered around these manufacturing facilities. In some cases, these clusters have involved hundreds and even thousands of firms with capabilities that no longer exist in the U.S. The existence of these capabilities pulls some higher level development activities such as prototyping to the manufacturing sites to take advantage of expensive

physical modeling and testing equipment, facilities for production engineering and so on. These capabilities are also pulling some design activities to the production location as the need for oversight of contractors and faster problem resolution to ensure speed to market means that designers must be close to development and manufacturing. On the other hand, in many cases we find that design can be separated geographically from development and production, and remains mostly in the U.S.

For software, proximity may be required to the onshore customer or end user, to high-cost firm specific assets that would be too expensive to duplicate offshore (e.g.,ATM network), or to mission critical operations which cannot be interrupted to switch them offshore. As major offshore locations such as India and China become important software markets themselves, such capabilities will likely develop in proximity to those markets. Also, as industry clusters develop in India and elsewhere, they begin to pull more firms to take advantage of the capabilities available in these clusters.

4 Offshoring of software continues to grow rapidly. We find that the offshore sourcing decision is driven by economic forces, primarily cost pressures, the need to find skilled workers, and the opening of fast-growing markets outside the developed world. Firms have responded to these pressures by seeking out offshore locations and adopting management practices to facilitate offshore migration, including codifying and transferring knowledge, standardizing processes and upgrading capabilities in offshore locations. Firms do not simply move activities that are easy to move, but look for every task that can potentially be relocated and work to expand the scope of offshore development.

Our recent findings, which are based on responses from 320 electronics firms, <u>reinforce many of the earlier findings</u>, but contain some new insights as well.

1. 45% of the firms interviewed have moved some new product development (NPD) offshore. The amount of work that is done offshore is much higher when NPD is outsourced than when it is kept inhouse, as many firms apparently outsource to developers outside the U.S.
2. The biggest reasons for moving NPD offshore are access to skilled people, reducing labor cost and increasing revenues
3. The biggest obstacles are the difficulty of knowledge transfer to offshore teams, IPR protection and cross-border culture and communications problems.
4. The biggest impacts are increased revenues and improved competitive position. Surprisingly, firms reported average cost savings of just 10%.
5. Higher levels of offshore manufacturing are associated with greater offshoring of NPD. The field interviews indicate that co-location of these activities results in greater efficiency and speed to market with new products.
6. Innovation activities close to the customer, such as concept generation and design are mostly still onshore, whereas those close to manufacturing, such as physical development and test, process engineering and sustaining engineering, are more likely to be done offshore.
7. Some firms that have outsourced NPD offshore also have moved some of their remaining internal NPD activities offshore. This likely reflects co-development between lead firms, contract manufacturers and suppliers.
8. Surprisingly, over 20% of firms that do not outsource any NPD conduct all or most of their R&D offshore, compared to just 10% for firms that do outsource NPD. R&D appears more likely to move offshore when firms design and develop their own products.

Challenges and Opportunities:
Fielding the survey has been a major challenge and has required working with industry associations, such as the Software and Information Industry Association (SIIS), American Electronics Association (AeA) and Product Development Management Association (PDMA). Getting an adequate survey response from software firms is being extremely difficult in contrast to

hardware firms. We are focusing survey resources on software firms in order to increase the response rate.

The survey results are coming at an opportune time in relation to a new administration in the US government. We will be making considerable effort to get these results before the Administration, Congress and the media. We also will be providing benchmark data back to the firms that participated in the study.

Project Title: Pathways to Health: Adaptation and Change in the Context of an Oil and Pipeline Project in Chad

Proposal Number: 0527280

HSD Emphasis Area: Agents of Change

Lead PI: Lori Leonard, Johns Hopkins School of Public Health

Co-PIs: Siba Grovogui, Johns Hopkins University, Department of Political Science; Daugla Doumagoum Moto, CSSI/Tchad

International Partner: Centre de Support en Santé International/Tchad (CSSI/T)

Project Goals:

- To examine how households in southern Chad respond to changes in property regimes, particularly the transition from communal land trusts to individual and private holding in the context of reforms introduced by the World Bank and a consortium of oil companies. We are tracking the implications of changing land tenure for the sociotechnical system of shifting cultivation, including agricultural production practices, soil systems, and the social organization of production.
- To investigate how land reforms and related changes in agricultural production practices, soil systems, and the social organization of production impact household food security.
- To examine shifts in patterns of household food consumption and the nutritional and health status of household members.
- To provide interdisciplinary training to researchers from the US and Chad and to contribute to the development of research capacity in Chad.

Thematic Areas:

- Land tenure reform
- Health transition
- Extractive industries and large-scale infrastructure projects
- Chad, sub-Saharan Africa

Methodologies:

We follow 160 households in five different localities. These localities include three small villages and a sub-regional center in the oilfield region and a peri-urban locality recently annexed to the capital city of N'Djamena. The localities were selected to allow for comparisons across settings that vary in terms of proximity to the oil and pipeline project; forms of household livelihood and levels of integration into the cash economy; and access to health care facilities and institutions of governance. Throughout the year, fieldworkers conduct household surveys on:

1. Cases of illness and household decision-making around care
2. Household revenues and expenditures
3. Food security and coping strategies
4. Dietary diversity
5. Agricultural production practices
6. Land loss and compensation received for the loss of property, its uses and management

We also conduct ethnographic interviews; soil sampling and nutrient analysis from soil and plant samples; inventories and geographic mapping of households' agricultural land and land use patterns; and anthropometry. We collect information on land related disputes. We have used GPS to map land claimed by the households and we are tracking soil fertility along with other

information related to soil quality and conservation practices in a sub-sample of the agricultural fields of village-based households.

Recent Research Findings:
The proportion of village households that received at least one compensation payment from the oil companies by the end of 2007 ranged from 42 to 91 percent. Many of these households have been expropriated multiple times (which is not reflected in the simple percentages). This also does not include land that was expropriated but was not compensated because the consortium considered it to be "bush." The compensation regime has led to the proliferation of "personal fields" cultivated by women. This is, in part, a response to declining production in over-used fields cultivated by men and in part a response to the compensation regime which recognizes only the person who cleared the field as the beneficiary of the compensation payments. This has generated a scramble for land in the context of a diminishing land base. The proliferation of "personal fields" cultivated by women and the individualization of production has led to conflicts over the relative contributions of men and women to domestic economies. Women's agricultural production is no longer discretionary; it is a necessary component of household production.

We collected and analyzed soil samples from 40 of the 120 village households. We found that soil quality was variable, but that the soils were consistently low in key nutrients, especially phosphorus, zinc, and sulfate-S. There were also problems with the physical properties of the soils, such as soil compaction caused in part by the implements farmers use to till the soil and in part by practices such as tilling immediately after a rain. Topsoils were also low in soil organic matter. There are relatively few low-cost and locally available options for improving soil fertility in the short term (although we have written a small grant to work with farmers on some techniques that could marginally improve yields). As the length of fallow is reduced or fallow is eliminated altogether following the continued expropriation of land, we expect that soil quality and yields will continue to decline with repetitive cropping.

We were also able to map the fields of village households using GPS devices. We had previously measured surface areas available for cultivation manually but have been able to improve the precision of these estimates using GPS technology. The use of GPS also allows us to easily calculate the distances between farmers' homes and fields, to track land expropriation and land use patterns over time, and to place the fields cultivated by households from different villages more easily in relation to one another.

Challenges and Opportunities:
The uncertain political situation in Chad proved a minor disruption to the project this year. In February during an attempted coup project staff went to Cameroon for several weeks. The research sites in the south of the country were unaffected by these events, but many of the members of the households that we follow in the capital city fled. Most have now returned. In terms of opportunities, we continue to have success in integrating student research and learning into this project. We have been flooded with requests for field placements and while we have not been able to accommodate all of them we have managed to take 2 to 3 students to Chad each year and to provide training in Chad or in Cameroon to our Chadian-based field researchers.

Project Title: Understanding Linkages Among Governance Factors of Linked Social and Ecological Systems

Proposal Number: 0527304

HSD Emphasis Area: Agents of Change

Lead PI: Tracey Dalton, Marine Affairs, University of Rhode Island
Co-PIs: Graham Forrester, Natural Resources Science, University of Rhode Island; Richard Pollnac, Marine Affairs, University of Rhode Island; Pamela Rubinoff, RI Coastal Resources Center; Bette Erickson, Instructional Development Program, University of Rhode Island

Project Goals:
(1) Understand how governance factors related to complex, dynamic marine ecosystems are linked to effective resource allocation;
(2) Identify natural science and social science factors that influence success of marine reserves;
(3) Explain why some reserves are more successful than others in enhancing environmental quality and institutional sustainability;
(4) Build sustainable working relationships among researchers in traditionally distinct disciplines and enhance interdisciplinary research skills; and
(5) Share key success factors with managers responsible for designing and monitoring marine reserves

Thematic Areas:

- Governance of coupled social and ecological systems
- Performance of marine reserves
- Marine resource management in the wider Caribbean

Methodologies:
To date, we have visited thirty marine reserves and 48 communities associated with the reserves. At each site, we collect the following data:

- Relevant reports and statistics from regional and local government offices
- Legislation or local ordinance establishing the reserve and other relevant legislation and management documents
- Key informants' perceptions and insights about the reserve (semi-structured interviews)
- Local community members' attitudes, knowledge and perceptions about the reserve (structured surveys)
- Fish and coral diversity and abundance (SCUBA surveys)

Recent Research Findings:
As we complete our data collection this fall, we are conducting the following analyses:

- Examination of the formal and informal governing arrangements linking humans and natural resources, the social and ecological context within which these arrangements are embedded, and the effect of these arrangements on the performance of marine protected areas
- Examination of the degree of homogeneity in intracommunity responses, degree of agreement between community members and project personnel, and congruence of responses with observed coral and fish conditions
- Examination of stakeholder participation in marine reserve planning and management and how it relates to marine reserve performance

Challenges and Opportunities:
There are research challenges: (1) Avoiding compartmentalizing the research so that each team member attends only to the components related to his/her specialty; (2) Becoming conversant enough with our colleagues' disciplines to engage in intelligent dialogue; and (3) Coordinating biological and social data collection for each site when some reserve sites are associated with more than one community and some reserve sites are located off-shore.

There are also opportunities: (1) Observing how data is collected in other disciplines; (2) Gaining a better understanding of our colleagues' disciplines; (3) Conducting multivariate statistical analyses that integrate data from all disciplines involved in the research; and (4) Producing future leaders in systematic, interdisciplinary research-based resource management.

Project Title: Decision Markets and Uncertainty in Weather Forecasting

Proposal Number: 0527332

HSD Emphasis Area: Decision Making, Risk, and Uncertainty

Lead PI: Gary Bolton, Penn State University
Co-PIs: Andrew Kleit and Anthony Kwasnica, Penn State University

Project Goals:

- Examine methods of communicating weather uncertainty to decision makers.
- Examine the efficacy of decision markets for providing weather related forecasts.
- Study how people use uncertainty information to make decisions.

Thematic Areas:

- Meteorology
- Decision making under uncertainty
- Experimental economics
- Decision/prediction markets

Methodologies:

- Experimental Economics
- Economic Theory
- Econometrics

Recent Research Findings:

Studies of weather uncertainty and decision making.

One manuscript we have in production examines three quantitative representations of uncertainty information: 1) perhaps the most commonly employed method: confidence or error intervals; 2) what, in theory, conveys the best information, probabilities; 3) what has in some cases proven to be a more effective way of conveying probability info, frequencies. There has been a movement to put probability information into forecasts. For example, the National Academy of Sciences recommends this on basis of theoretical models and surveys that show people favor seeing probabilities. But there is little evidence to suggest this information actually improves decision making, outside of areas where experts trained in decision analysis are employed. There is also a great deal of data raising questions about peoples' ability to use this information properly.

We test three cases of the road salting problem, a standard cost-loss game: A case where people have only point forecasts versus point and probability forecasts versus point and error forecasts. So we compare the use of probability information against two benchmarks: no uncertainty information and an alternative representation of uncertainty which adds value, though in theory, not as much as having probability info but is also easy to understand. An earlier work of ours was unable to distinguish any extra value from adding probability info to error info.

The design of the experiment permits us to check whether people are accounting for cost/loss ratios in their decisions. Forecasts and weather patterns are calibrated to get good separation for four archetypes users: naive, optimal, salt when point below 34F and salt when point-error below 32F would make different decisions. With regard uncertainty information, there are two key questions: Whether the information gets incorporated into decisions, and, if so, how much people benefit from it. Checking how the distribution of archetypes changes across treatments addresses the first question and comparing with archetypes within treatment addresses the second.

Studies of decision markets for weather forecasting.

We have now conducted weather forecasting decision markets for two academic years. These markets have closely paralleled the national collegiate weather forecasting competition known as

the WxChallenge. We have conducted markets for 22 different locations on two different days for each location. In addition, we have conducted markets for 22 different days for State College, Pennsylvania (the home of Penn State University).

Markets have been conducted to provide forecast of both the high and low temperatures at the particular location and day. Hourly forecasts from prevalent forecasting sites (weather.com, accuweather.com, etc.) have also been collected in order to provide a comparison with the predictions of the market.

In general, the markets involved traders from the Penn State University student population with an emphasis on attracting meteorology and business school students. Approximately, 30 to 40 students participated in each market.

The market results can be summarized as follows

- The high or low temperature predictions provided by the decision market are as accurate as those provided by professional forecasting services.
- The markets do not exhibit any systematic biases and perform nearly as well for most location, days, etc.
- Expert traders (meteorologists) earn substantially higher profits and trade more often than non-expert traders.
- The markets appear to provide valuable information about the uncertainty associated with the current weather forecast.
- The inclusion of a more familiar 'near' market (State College, PA) does not make the 'far' market less accurate as predicted by some theories.

In addition to conducting these markets we have also conducted laboratory experiments with historical data in order to provide a more controlled study of the role of asset structure on information aggregation in these markets.

Challenges and Opportunities:

Studies of weather uncertainty and decision making

We are in the process of gathering information to study the 'cry wolf' problems (alternatively known as the false alarm phenomenon). Cry wolf refers to the tendency of people to discount advice to evacuate the path of an oncoming storm because of inaccuracies in past forecasts. We are studying alternative warning methods to see which are most credible to people.

Studies of decision markets for weather forecasting.

Our current efforts are focusing on two important areas in decision markets design. First, we are using future weather decision markets to study what factors might make market perform poorly. For example, we hypothesize that an 'experts only' market might not perform as well due to concerns about strategic trading that is well known in market theories in economics and finance. Second, we are exploring methods to refine the uncertainty information provided by market trading. We believe the truly valuable addition of these markets is this information; traditional forecasting sources do not typically provide uncertainty information. However, the quality and methods of generating this information must be studied further.

Project Title: The Repression and Dissent Nexus in the Middle East

Proposal Number: 0527339

HSD Emphasis Area: Agents of Change

Lead PI: J. Craig Jenkins, Katherine Meyer; The Ohio State University
Co-PIs: Phil Schrodt - University of Kansas, Lawrence, KS; Mary Ann Tétreault - Trinity University, San Antonio, TX; Jillian Schwedler – University of Massachusetts, Amherst, MA; Christian Davenport - University of Maryland, College Park, MD
Consultant: Helen Rizzo, The American University in Cairo, Egypt

Project Goals:
Focusing on several important nations—Egypt, Israel/Palestine, Jordan, Kuwait, and Turkey—during the 1990's, this project investigates the interface between repression and dissent in the Middle East in order to advance understanding of the prospects for globalization and democratization in the region. Using these key nations, we examined the process of transformational change and the implications of cultural variation for conflict.
Research goals of the project entail: (1) developing research models which include dynamic and interactive processes in sociopolitical systems which are affected by far-reaching and often violent repression and dissent; (2) creating a database which incorporates data from both qualitative and quantitative sources; (3) developing interdisciplinary and international partnerships involving senior and junior faculty; (4) professional training of and collaborative work with graduate and undergraduate students; and (5) utilizing interdisciplinary, multi-methodological social science research.

Using event analysis, field research, and survey analysis, the current research surpasses many previous studies, which focused on either a single nation or methodology. It refines the concepts of repression and dissent in response to problematic theoretical issues of prior research. And it considers the social, political and cultural contexts of the nations studied; these are often disregarded.

Research questions include:
- How do repression and dissent influence one another over time - e.g., monthly, annually?
- What types of state action generate what types of dissent and vice versa?
- What are the social, political and cultural contexts which shape contentious behaviors?
- What consistencies and inconsistencies exist in the nations regarding the nature of dissent, its sources, and contexts?

Thematic Areas:
The importance of context: The team has completed the projects of the third year. The research incorporated in-depth interviews in the nations along with survey and event data and content analysis of multiple news sources. Work of both undergraduate and graduate students has been fundamental in investigating the dynamics and theories of repression and dissent during the 1990s.

The team has devoted much of the year to studying the cultural and political contexts in which contentious activities arise. From the six territories, several significant contexts emerged:
- The definition and importance of rentier status, both foreign aid and oil revenues, which creates internationally dependent states.
- The size and out-migration of both Kurdish and Palestinian populations within the Middle East, creating highly mobilized diaspora communities.
- The importance of remittances in diaspora communities, which spur global communication and the transnational transfer of capital.

- The importance of civil society and organizations (both religious and secular) in the region, which transforms political opportunities and creates networks among activists.
- The importance of networking amongst both organizations and migrants, providing opportunity for cultural transformation, framing of grievances, and exchange of capital.

The distinctiveness of issues: We found that diverse and unique factors fueled contention in each nation. Varieties of religious restriction and regulation, gender equity ideologies, protest potential, and colonial history mattered in several nations. Issue frames were important to understanding Israel and Palestine. In Turkey, the international stage, human rights pressures, policing and security were important factors in state action. Civil society and organizations (both secular and religious) mattered to the development and sustainment of contentious activity in all nations.

Methodologies:
This project utilized various methodologies and data sources. Data sources include those used at The Ohio State University: World Handbook IV, which provides event data from Reuters on relevant territories; Europa World Online Reports and Keesing which provides condensed country reports for the six nations; Lexis-Nexus Dissent and Repression News Stories for the six territories; the Kuwait General Social Surveys for the 1990s, country-specific demographic data and the World Values Survey; The Religion and State Dataset from Fox; and the CIA Factbook. At the University of Kansas, the Kansas Event Data System (KEDS) provided event data from Agence Francaise Presse. Fieldwork data was employed this year at the American University of Cairo, the University of Massachusetts (Jordan), and Trinity University (Kuwait and Turkey). And the Minorities at Risk dataset was utilized at the University of Maryland

Recent Research Findings:
Recent research conducted by the team uncovered several important relationships between repression and dissent in the region.

- Cycles of violence demonstrated that violence is self-sustaining, and ends only when one or more contenders are disorganized or defeated.
- Non-violent civil protest showed no effect on state sanctions or violence.
- State restrictions produced civil protest in more autocratic settings (Egypt) and violent civil reactions in polarized settings such as Israel/Palestine. They did not provoke civil action in the remaining states.
- State restriction was often imposed through violent measures, which reinforced claims to control public order, suggesting that civil conflict cycles are largely sustained by violence.
- When civic actors and engage in nonviolent contentious activity, there was no uniform response from the state.

Challenges and Opportunities:
The project was rich with challenges and opportunities related to the research goals above.

- Explaining conflict in the Middle East through attention to detailed cycles of state violence, sanctions and civil violence and protest in each nation using multiple methods of data collection has provided both an opportunity to examine the utility of theories of repression and dissent, and a challenge to correct and modify theoretical models. (Research goals 1, 2 and 5.)
- Utilizing multiple methods had made it possible to extract characteristics common to nations in the region, through attention to the social, political and cultural contexts of each nation, a significant move beyond previous generalizations based on case studies. (Research goals 1, 2, and 5.)
- The social and political importance of the topic has facilitated important and valuable cross-disciplinary and international opportunities for both graduate and undergraduate students, as well as faculty. (Research goals 3 and 4.)

Project Title: Rumor Propagation: Modeling & Testing Dynamic Social Influence Mechanisms

Proposal Number: 0527371

HSD Emphasis Area: Dynamics of Human Behavior

Lead PI: Nicholas DiFonzo, Rochester Institute of Technology (nxdgss@rit.edu)
Co-PIs: Prashant Bordia, University of Southern Australia; Martin J. Bourgeois, University of Wyoming; Bernard P. Brooks, David S. Ross, Christopher Homan, Rochester Institute of Technology; Jerry M. Suls, University of Iowa
Collaborators: Jason Beckstead, University of South Florida

Research Goal:

1. To model and understand how rumors propagate over time and across social space.

Thematic Areas:

1. Rumor
2. Dynamic Social Impact Theory
3. Math Modeling

Methodologies

1. Math Modeling on Social Networks

Dialogue Model. We used our "Dialogue" model of rumor propagation to create a stand-alone computer program (Guanxi) to simulate rumor propagation on networks of various types and sizes. Guanxi is modular and customizable. The experimenter can learn how parameter changes in the Dialogue model, and network configuration, affect the population mean belief in a rumor, in-group or out-group mean belief, and belief clustering over time.

Modeling of CAPS Data. We adapted the Dialogue model to predict rumor choice and belief patterns in our Computer Assisted Panel Study 1, then tested this model on actual data from computer assisted panel Study 1 from last year.

2. Lab Experiments

Belief-Repetition Study 2. We conducted a second experiment to understand the relation between hearing a rumor repeatedly and belief. Ten different rumors were embedded between zero and nine times in narratives that 220 participants read. Participants then rated how believable they found each rumor to be. Participant skepticism was also measured.

Motivation in Rumor Spread. We are developing an instrument to measure motivation in rumor transmission, to be used in a laboratory study on defensive rumors.

3. Computer-Assisted Social Network Experiments

Study 2: Rumor Clustering & Consolidation. We conducted a second computer assisted panel study. Data from 33 16-person groups were collected at Rochester Institute of Technology, University of Wyoming, and the University of South Australia. Each group read several ambiguous scenarios and communicated via a computer terminal with four other individuals. During each scenario, participants were presented with four alternative statements (rumors) that made sense of the scenario and were asked to discuss which alternative made the most sense. Discussion proceeded over four simultaneous "chat rooms" of communication with four individuals. After reading these alternatives, participants indicated privately which of four rumors made the most sense to them and how much confidence they had in that alternative, and then discussed the messages with each of their four neighbors. After discussion, they again registered their rumor choice and confidence. Rumor choice and confidence was thus measured twice for each scenario. Network configuration was varied within-group.

Study 3: Defensive Rumor Clustering & Consolidation. We designed and are currently collecting data for a third computer assisted panel study in which participants who self-identify as Democrats or Republicans discuss a series of nine defensive rumors. The rumors are considered defensive because they are Democrat-positive, Democrat-negative, Republican-positive, or Republican-negative, and displayed significantly different levels of belief in a pretest of materials between Democrats and Republicans. Network structure and the degree to which each group is

integrated are also varied. We are interested in how configuration, integration, and discussion affect belief and belief clustering of these types of rumors.

4. Web-based Surveys

Cancer Rumors. We administered a web-based survey of participants in cancer discussion and support sites. The aim of the survey was to describe current cancer rumors, and assess factors in transmission, including formal and informal network transmission patterns.

5. Field surveys

Defensive Rumor Belief & Transmission. We administered several surveys to members of rival campus groups, and also to members of rival political parties. These surveys presented participants with defensive and non-defensive rumor statements (ingroup-positive, outgroup-positive, ingroup-negative, & outgroup-negative) and recorded their level of belief and/or their likelihood of transmitting the rumor to members of their personal social network.

6. Archival Study

Rumor Activity over Time. We identified sources of archived rumors; these sources provide data on rumor activity over time for a number of different rumors in circulation.

Recent Research Findings:

1. Math Modeling on Social Networks

Dialogue Model. The Guanxi program was used to perform numerous parameter studies. Each of these studies was about spread and belief in a negative rumor about one group in the context of conflicted groups. One preliminary finding points toward the importance of the "novelty floor" parameter (the willingness of participants to continue discussing rumor despite its age). This factor greatly influenced the extent to which two groups polarize with regard to belief in a negative rumor.

Modeling of CAPS Data. Using Study 1 computer assisted panel data, we calculated optimal parameter choices for our mathematical model.

2. Lab Experiments

Belief-Repetition Study. Using hierarchical linear modeling techniques, we replicated findings from Study 1 (belief in a rumor is logarithmically related to the number of times the rumor is heard). Skepticism moderated this relationship, but only slightly.

3. Computer-Assisted Social Network Experiments

Study 2: Each condition became less diverse (with respect to rumor choice) with discussion; network configuration did not affect change in diversity. Each condition became more clustered (with respect to rumor choice) with discussion, except when the network was configured as a torus (i.e., a lattice). Each condition became more confident in their responses, regardless of network configuration.

Study 3: Data is currently being collected.

4. Web-based Surveys

Cancer Rumors. Web survey responses from 188 participants found that both negative and positive rumors were transmitted. While participants held more faith in medical sources, 71 percent changed their behavior after hearing a rumor from a non-medical person. Results suggested that rumor participation aided coping with the disease.

5. Field surveys

Defensive Rumor Belief & Transmission. Preliminary data analysis suggests that participants are more likely to believe a positive than a negative rumor when the target is their ingroup; this tendency appears to be reduced when the target is their outgroup.

6. Archival Study

Rumor Activity over Time. Data are currently being analyzed.

Challenges and Opportunities:

Group studies continue to be logistically challenging: finding members of the minority (smaller) group that are available for participation is difficult. Finding access to an archived set of rumors was also challenging.

Project Title: DHB: Transformed Social Interaction in Virtual Environments

Proposal Number: 0527377

HSD Emphasis Area: Dynamics of Human Behavior

Lead PI: Jeremy Bailenson, Stanford University
Co-PIs: Jim Blascovich, Andrew Beall, University of California, Santa Barbara

Research Goals:
1. Understanding digitally mediated social interaction.
2. Measuring the impact of transforming identity.
3. Developing immersive virtual environment technology to answer social science questions.

Thematic Areas:
1. Media and Communication
2. Social Psychology
3. Software/Hardware application development

Methodologies:
Laboratory Experiments, Field Studies in Online Virtual Environments, Prototype Development for Hardware and Software.

Recent Research Findings:
In last year's update, we introduced the concept of *The Proteus Effect*. Cyberspace grants us great control over our self-representations. At the click of a button, we can alter our gender, age, attractiveness, and skin tone. But as we choose our avatars online, do our avatars change us in turn? In the studies summarized last year, we described how varying participants' avatars changed how they behaved in a virtual environment. We demonstrated that when participants looked in a virtual mirror and saw themselves as attractive, they were more social in a virtual world. Avatar height had a similar influence on negotiation tasks.

This year, we have focused on three advances with the Proteus Effect.

The first is *transfer*. In a series of studies we have demonstrated that one's representation inside of VR actually affects subsequent behavior outside of the lab. For example, if a person is represented with an attractive avatar inside of VR, on hour later they implicitly embody a mental state that causes them to behave more confidently in a dating situation. Similarly, if a person is 10 cm taller than another in an initial virtual meeting, that person is more likely to defeat the other person in when the two meet face to face later, even though neither of the negotiators reports any conscious detection of the virtual height differential. Finally, one's virtual body shape changes physical exercise habits up to 24 hours after the virtual exposure.

The second is *psychological mechanism*. Using control conditions of watching videos, we have demonstrated that it is not simply visual priming that causes the effect, but that it depends upon the fact that the individual controls the representation. It is the individual's embodiment of the avatar that underlies this phenomenon. Moreover we have demonstrated that visual avatars cause more changes in behavior than textual descriptions of the self.

The third is *replication and extension*. In the past year we have experimented with changing race, body size, and age of the avatar, and demonstrated changes in attitudes, behavior, and cognition as a consequence of these virtual identity shifts.

In another line of research, we have been examining the influence of avatar audiences on an individual's behavior. Nonverbal behavior of other people in a scene, regardless of whether those

people are digital or physical, has implicit effects on the cognition and behavior of an individual placed in their midst. In one study, participants sat in a virtual room with a group of embodied agents (virtual representations controlled by a computer program) while one of the agents delivered a detailed persuasive passage. Over the course of the passage we manipulated the gaze behavior of the embodied agents in the audience, such that they oriented more or less frequently and for more or less of the time. We found in this study that participants learned more and spent more time attending to the speaker when the audience spent more time oriented toward the speaker. Moreover, we found that when an audience repeatedly looked away from a speaker, it detracted from the participant's own orienting behavior and learning.

These findings speak not only to digitally mediated social interactions, but address larger questions about social orienting and audience effects on nonverbal behavior, persuasion and learning.

Challenges and Opportunities

One of the biggest challenges remains expanding our research from the laboratory to larger scale projects. Four months ago we ran a large sample size, longitudinal study of how avatar representation effects behavior in the online social world Second Life. Extending our work to these online arenas in which people use avatars naturalistically presents an amazing social science research opportunity, given the amount of time people spend in social networking websites, online dating, networked video games, and virtual worlds. The challenge we are currently facing is how to draw valid inferences from behaviors in the online worlds that a) create very large statistical data sets, and b) do not provide as much experimental control as the laboratory virtual reality simulations.

Project Title: DHB: Mathematical and Simulation Modeling of Crime Hotspots

Proposal Number: 0527388

HSD Emphasis Area: Dynamics of Human Behavior

Lead PI: P. Jeffrey Brantingham, UCLA Anthropology
Co-PIs: Andrea Bertozzi, UCLA Math; Lincoln Chayes, UCLA Math; George Tita, UCI Criminology, Law and Society.
Collaborations: Los Angeles Police Department, Long Beach Police Department

Project Goals:

- Develop in parallel computational and analytical models of crime pattern formation.
- Assess the degree to which crime patterns are predictable based on these spatio-temporal models.
- Model and evaluate the impact of various security responses to crime patterns (e.g., hotspot policing).
- Test model crime systems against recent crime data.

Thematic Areas:

- Criminological theory.
- Pattern formation theory.
- Computational and mathematical modeling.
- Crime prevention.

Methodologies:

- Agent-based models.
- Partial Differential Equation models.
- Geostatistical analysis of crime.

Recent Research Findings:
The core premise underlying our discrete and continuous models is that crimes occur when motivated offenders and potential targets/victims convergence in time and space in the absence of any security measures. Crime pattern formation is therefore cast as a physical process of how the different components of crime move and how the mix in complex urban environments.

Through the development of a null hypothesis based on a temporally heterogeneous Poisson process, we have confirmed that residential burglary displays a statistically significant “repeat victimization effect”; houses that have been victimized once experience an elevated risk of being revictimized again in a short period of time. We have also confirmed using a variant of the same model that this elevated risk spreads to the neighbors of victimized house. We have been able to measure a similar spatially localized repeat effect for car theft and assault, but no apparent signature that risk spreads among neighbors for these latter crime types. Results of the burglary analyses are under review at the *Journal of Quantitative Criminology*.

We have identified the characteristic dynamics of residential burglary systems: (1) spatially homogeneous crime; (2) stable crime hotspots; and (3) transitory crime hotspots. State 3 is observed only in the discrete system because of finite-size effects and the transition between system states 2 and 3 have been linked to the relative density of burglars in the system. Linear stability analyses provide link the size of perturbations (i.e., crime spikes) to measurable geospatial properties of crime hotspots. Results of this work were published in *Mathematical Models and Methods in Applied Science* (Vol. 18, sup. 1: 1249-1267).

Weakly nonlinear analyses of the PDE burglary models identify the possible formation of subcritical crime hotspots under conditions that are linearly stable. This suggests that crime

hotspots may nucleate from a stable uniform crime distribution given a large enough spike in crime; smaller spikes in crime under these same conditions do not nucleate into crime hotspots. This finding also implies that subcritical crime hotspots may also be completely eliminated with a large enough security surge.

We have simulated a range of policing strategies including so-called hotspot policing and have identified the conditions under which small numbers of police can eradicate crime hotspots given only a spatially localized deterrent effect.

Empirical comparisons have concentrated on calibrating burglary and target density in the model against known housing densities in a portion of Los Angeles. Our models qualitatively match the empirical record and provide a foundation for developing statistical forecasting tools.

Challenges and Opportunities:
This project has generated research opportunities at all levels of the UCLA system.

Two new postdocs joined the project in 2008. George Mohler (PhD, UCSB) is a specialist in stochastic partial differential equations. Alethea Barbaro (PhD, UCSB) is a specialist in large-scale parallel computational modeling.

A new graduate student Nancy Rodriguez (Math, UCLA) joined the project in 2008 and is working on both nonlinear analyses of the models and studies of gang organization and violence based on PDE models of wolf territory formation.

Eight REU students, funded through the UCLA Math, participated in the UCLA “Disaster LA Project” wherein they developed an hypothetical scenario for a series of coordinated terrorist attacks in Los Angeles and illustrated how various mathematical techniques, including those from the current project, could be used in analysis of and response to the attacks. Results are of the Disaster LA Project are posted at:

http://www.math.ucla.edu/~mbshort/Disaster_LA

Project Title: DHB: Multilevel ARMA and Dynamic Models for Longitudinal Data and the Study of Human Interactions

Proposal Number: 0527449

HSD Emphasis Area: Dynamics of Human Behavior

Lead PI: Michael J. Rovine, Penn State University

Project Goals:

- Develop hidden Markov model to model mother infant interaction
- Develop Association rule mining strategy to describe mother infant interactions
- Develop control algorithm based on state-space model

Thematic Areas:

- Statistical models
- Engineering models
- Dyadic interactions

Methodologies:

- Hidden Markov Models
- Association rule mining
- State space and control models

Recent Research Findings:

Using a hidden Markov model to describe mother-infant interactions during a stressful event (an inoculation at a physicians office), we were able to show individual differences that seem to relate to increasing a desired learning state of the child. An increase in this learning state is hypothesized to increase the child's ability to emotionally self regulate. Using the DEPMIX approach to the hidden Markov model, we established a 6-state model at 2 month physicians visit and a different 6-state model at a 6 month physicians visit. This definitions of the states at six months suggested that the mother was providing soothing strategies that better allowed the child to move from the most distressed state to more fussy and observant state and finally to a non-distressed state. This sequence is thought to increase the probability of the child's learning to self-regulate. Individual differences in the sequence were generated using posterior probabilities of state membership generated under the model. A comparison of the two and six month models indicates lack of this characteristic at two months. This indicated development over the 4 month interim resulting in dyads achieving this more desirable state. Individual difference measures at both ages allow us to identify who is changing in this manner.

Methods for developing derived measures to describe the dynamics of the interaction include summary measures based on the posterior probabilities, appropriateness of the model based on the scaled contribution of each dyad to the loglikelihood, and more qualitative measures based on the occurrence of particular sequences and durations in the measure of distress. For the different models that occurred at different ages, some additional strategies were also included. A recursive approach to subgroup determination was used. This involved computing a common model. Using the scaled contribution to the loglikelihood to determine which dyads were not described by the model, removing them from the model, and then computing a new model for those dyads. This process was repeated recursively until the proper number of subgroups was determined. Association between group membership at two and six months was used to indicate stability and change.

Comparing this method to other approaches used to analyze such data including Yule's Q, Bakeman's sequential analysis, and the more recent graphical approaches to interaction analysis (e.g. GridWare), we delineated the advantages of the hidden Markov approach.

Since the current results are based on common group models in which the individual differences are predicted posteriors, we are working on estimating a separate model for each dyad and using these results to develop derived variables, group dyads, and describe individual differences.

Challenges and Opportunities:
Challenges include developing an efficient strategy to estimate individual models and group dyads based on model similarity. This requires developing appropriate criteria for determining model similarity. The scope of this problem becomes relatively large since the hidden Markov model is already a computationally intensive model. As a result we are working on methods to automate the process including a front end that can generate code for the DEPMIX procedure.

Challenges also include determining methods for comparing qualitatively different models. The approach that we are taking involved defining invariance at the latent variable (state) level and using that definition to allow comparisons based on the levels of the manifest variables. This represents a problem similar to that found in the factor analysis literature. It represents a significant challenge for this project.

Opportunities include interactions with a number of researchers with similar kinds of data who have shown great interest in the hidden Markov approach. As a result, we have begun a number of collaborations in which we are helping researchers to develop and apply their own models.

Project Title: Investigating the Dynamics of Free/Libre Open Source Software Development Teams

Proposal Number: 0527457

HSD Emphasis Area: Dynamics of Human Behavior

Lead PI: Kevin Crowston, Syracuse University School of Information Studies
Co-PIs: Elizabeth Liddy, Robert Heckman and Nancy McKracken, Syracuse University School of Information Studies
International Partners: Politecnico di Bari, Bari, Italy

Project Goals:

- to describe how members of self-organizing distributed teams (specifically teams of Free/Libre Open Source Software developers) develop shared mental models to guide members' behavior, roles to mediate access to resources, and norms and rules to shape action
- to describe the dynamics by which independent, geographically-dispersed individuals are socialized into these teams

Thematic Areas:

- dynamics through which individuals and organizations (including families and other informal organizations) create, grow, learn, change, and act
- systems of coordination and control in the behavior of individuals, the dynamics of coordination between individuals, and the dynamics of change across the lifespan of individuals and organizations

Methodologies:

- social network analysis of team interactions
- manual and computerized natural language processing (NLP) content analysis of developer interactions
- concept mapping from interview transcripts to extract shared mental models

Recent Research Findings:
Dynamic SNA of developer interactions confirms our earlier findings that FLOSS projects display highly distributed centralizations. The data also show that participation in the project follows a highly skewed distribution over time. The dynamic data provided insights into network structures. Specifically, some projects that appear decentralized when examined as a snapshot collapsing interactions over time are actually centralized when examined dynamically, but with the individuals at the centre changing over time. However, the data suggest that the majority of projects analyzed maintain a single participant at the center through their lifetimes. This finding held even for projects with many participants.

In addition, we found that participation varies by venue of communication, such that patterns of contribution in different genres of project communications are distinctly differentiated. While we have observed that all communication venues tended toward decentralized participation over time, we also identified multiple conflicting reasons that this phenomenon may occur, such as loss of project leadership versus growth of user base. Our analysis also uncovered patterns of project management "housekeeping" behaviors that may confound social network analyses based on bug tracker data sources; these behaviors can be attributed to multiple causes, such as sufficient growth to merit the observed periodic maintenance, and alternately, preparation for closure of project activities.

A contribution to the field of software engineering was made by our study published in a software engineering journal (the *Information and Software Technology Journal*). In the study we found

clear differences in the coordination mechanisms used to manage task-actor dependencies in FLOSS projects as compared to conventional software development projects. We suggest how these emergent practices might usefully be transferred to mainstream practice and thus have an impact of software engineering. The article is also a methodological contribution, as it demonstrates how qualitative analysis can be applied to software engineering research,

In our coding of interactions to uncover team practices, we focused initially on identifying team decision-making practices. In a study of six FLOSS teams, we manually coded 258 software modification decision episodes, identifying how problems were identified, solutions developed and evaluated and decisions announced. We identified six decision-making paths: 1) short-cut (identification directly to announcement, 28% of episodes); 2) implicit-development (1%); 3) implicit-evaluation (31%); 4) normative (all stages in order, 2%); 5) dynamic (repeated loops through the stages, 29%); and 6) interrupted/ delayed (a problem and discussion but no final decision, 9%). We suggest that the nature of the tasks and the affordances of the technology used reduce the need for explicit coordination, resulting in a broader range of possible decision processes than are observed in face-to-face groups.

In order to analyze more projects, NLP rules were developed to identify decision announcements and decision trigger sentences. As a test, we applied the rules to messages within three of the manually coded projects. The results show that across the projects analyzed, the automatically applied rules can reliably identify 63-72% of the decision triggers that were manually coded, and 71-85% of the decision announcements that were manually coded. Due to the subjective nature of content analysis coding, however, the more interesting metric of Utility was used, that is, the measure of how useful the identified decision announcements and triggers are to the researcher. Utility is consistent across all three projects at approximately 80% for decision announcements and 85% for decision triggers. The identified decision announcements and triggers contained not only statements that were originally identified manually, but also potentially missed decision announcements and statements. The NLP results thus seem likely to permit a more sophisticated analysis of the decision process evident in the data. This work is a major step towards the development of NLP-based automatic coding tools to enable the analysis of large volumes of data with high accuracy and excellent recall. Combining manual content analysis with NLP will contribute to social science more broadly, as researchers are increasingly interested in examining the rapidly growing volume of data that captures traces of online social activity. We are currently shifting the focus of manual and NLP coding to group maintenance behaviors in the teams.

Our pilot study of shared mental models found variance in the sharing of mental models, depending on the area and the participant's roles. As to the interpretive schemes, key definitions (e.g., project goals, users and challenges) have a high degree of sharing among the three core developers we interviewed. Some aspects of the cause maps are shared as well. For example, concepts related to project success/strengths, challenges and the role of community are central and/or relevant in most maps. As to roles, all four members we interviewed stressed the importance of community. Finally, norms and rule show a high degree of sharing. However, some differences in the views of developers also emerged, some seeming related to tenure in the project, which indicates dynamic processes over time.

Challenges and Opportunities:
The project has encountered several challenges in carrying out the research. A first challenge is that large amount of raw data about FLOSS team activities are available, which poses serious data management and curation challenges. This challenge poses an opportunity, as developing better approaches to making this data available will support the larger research community doing research on FLOSS development. There are also some interesting privacy issues that arise in analyzing data about individuals that are already published on the Internet.

On the other hand, the public data on FLOSS development represents only a partial view of the team practices. Furthermore, as the data are only trace of behaviour, considerable conceptualization is necessary to raise the level of abstraction to link the data to interesting

theoretical questions. This challenge poses the opportunity for testing social science theories based on a novel source of data.

Manual content analysis of email messages is very time-consuming, involving multiple passes through to develop reliable coding schemes. Even with the use of NLP for coding, manual coding is needed to provide “gold standard” data to validate the NLP rules. We are hoping to turn this challenge into the opportunity to develop better tools for qualitative data analysis, but for the short-term, it’s just a challenge.

Project Title: Coordinated motion and facial expression in dyadic conversation

Proposal Number: 0527485

HSD Emphasis Area: Dynamics of Human Behavior

Lead PI: Steven Boker, University of Virginia
Co-PIs: Jeffrey Cohn, University of Pittsburgh; Simon Lucey, Carnegie Mellon University

International Partners: Barry Theobald, University of East Anglia, UK

Project Goals:

- Evaluate the contributions of timing and amplitude modulation of nonverbal cues on the dyadic conversation by independently modulating the timing and extent of head movements, facial expressions, and vocal pitch.
- Evaluate effects of gender on conversational coordination by replacing the image used to reconstruct an avatar with the image of a person of opposite gender and by modifying vocal formants to be those of a person of opposite gender.
- Build a combined differential equations and computational model for coordinated head motion and evaluate this model from ratings of ``naturalness'' and by testing the extent to which computer animated motions generated by the model in real time produce appropriate feedback response in the human conversants.

Thematic Areas:

- Coordination dynamics, social cues, and expression of affect during conversation.
- Automated tracking and real-time video synthesis of facial expressions.

Methodologies:
Two participants speak with one another over closed circuit video. The video is back-projected and a miniature video camera is arranged so that conversants see each other life size approximately 1.5m from each other and eye gaze is correct within 5 degrees of visual angle. One conversant is a confederate and motion tracked and the face that the other (naive) conversant sees has been manipulated and resynthesized and the voice that they hear has been processed. Manipulations include timing delays, reduced affect (both in facial expression and in vocal inflection), and person/gender substitution. In the reduced affect and person substitution conditions, new algorithms were developed as part of the project. Person substitution tracks the facial expressions and head motions of the confederate and applies these to Active Appearance Models (AAMs) constructed from previously recorded video of another person. When there is a change in gender of the apparent conversant, the vocal characteristics are processed using formant algorithms to pitch shift the voice to an appropriate register.

This novel methodology is, to our knowledge, unique and is transformative in that it allows a broad range of psychological questions to be addressed that previously were not practicable.

Recent Research Findings:
We found evidence of compensatory mechanisms in amplitude and velocity of head movements during conversation such that when amplitude of head movements, facial movements, or vocal inflections were reduced in the avatar or when the avatar was delayed, naive conversants produced higher amplitude head movements. Confederates were blind to when these manipulations were present or not present. The compensatory increase in animation may be linked to a perception by the naive conversant of depressed affect in the confederate. Mild depression is often associated with reduced and/or delayed facial affect and vocal inflection and can elicit compensatory responses in conversational partners.

During conversation, women tend to nod their heads more frequently and more vigorously than men. An individual speaking with a woman tends to nod his or her head more than when

speaking with a man. Is this due to social expectation or due to coupled motion dynamics between the speakers? We present a novel methodology that allows us to randomly assign apparent identity during free conversation in a videoconference, thereby dissociating apparent sex from motion dynamics. The method uses motion--tracked synthesized avatars that are accepted by naive participants as being live video. We find that 1) motion dynamics affect head nods but that apparent sex does not; 2) judgments of sex are driven almost entirely by appearance; and 3) ratings of masculinity and femininity rely on a combination of both appearance and dynamics. Together, these findings are consistent with the hypothesis of separate perceptual streams for appearance and biological motion. In addition, our results are consistent with a view that head movements in conversation form a low level perception and action system that has equilibrium dynamics independent of top--down social expectations.

Challenges and Opportunities:
We are currently working on analyses to extract and model interpersonal coordination in facial movements during the dyadic conversations that have been recorded during the experiments funded by this project. We believe that these coordinated motions will be related to ratings of personality in a “thin slices” rating paradigm.

We are currently in the process of running an experiment in which racial and gender appearance are both swapped in a 2x2 design. Again, the person whose appearance is being manipulated will be blind to what sex and race their videoconference interlocutor perceives them to be. Each confederate will appear as 4 different individuals and will be rated on personality 4 times by each naïve participant. In this way, we expect to gain a better understanding of how dynamics and appearance contribute to perceptions of personality.

Project Title: Accelerating the Diffusion of Innovations: A "Digital Diffusion Dashboard" Methodology for Global Networked Organizations

Proposal Number: 0527487

HSD Emphasis Area: Dynamics of Human Behavior

Lead PI: Julia C. Gluesing, Wayne State University
Co-PIs: Kenneth R. Riopelle, Wayne State University and James A. Danowski, University of Illinois at Chicago
Collaborators: Ford Motor Company, Chrysler Corporation, General Motors Corporation, IBM, Visteon Corporation, Wayne State University School of Medicine, Southeast Michigan Center for Medical Education

Project Goals:

- This project represents an interdisciplinary collaboration between the fields of engineering, anthropology and communication to combine expertise in information technology, ethnography, and semantic network analysis to study diffusion networks and give voice or ground truth to the actual ways innovation is diffused within an organization.
- The study will advance the practice of organizational change and help accelerate the diffusion of innovations in global networked organizations by investigating, documenting and validating a new methodology using existing information technology network infrastructure, and by developing techniques to dynamically plan, monitor and manage the diffusion of innovations and organizational change in real time.
- Simple, clear and reusable indicators for a "digital diffusion dashboard" will open a new frontier for both scholars and practitioners alike. Our research partners include Ford Motor Company, General Motors Corporation, Chrysler LLC, Visteon Corporation, Wayne State University School of Medicine, and the Southeast Michigan Center for Medical Education (SEMCME).

Thematic Areas:

1. Communication and social network research as it intersects with new approaches to diffusion theory in online organizational systems;
2. Relationship between technology and the human and social dynamics of change;
3. Dynamic display of diffusion patterns associated social networks, and message networks.

Methodologies:

- Collecting email from innovation team members in real time; displaying the dynamic communication networks and the central content of messages about the innovation as it occurs; measuring the properties of diffusion curves, network structure, and changes in message content.

- Conducting ethnographic research, including interviews and observation of interactions among innovation team members, to validate and supplement data gathered using automated means.

- Crawling the intranet and internet (including web portals, team collaboration centers, blogs and wikis) to display web-based diffusion network structure and content.

Recent Research Findings:

Our initial findings from analysis of a global innovation include:

- Significant diffusion events are reflected in the content and structure of email communication networks. For example, the merging of innovation teams in Europe and the U.S. can be seen in the changes in frequency of word pairs that emerge in comparing emails generated at two different points in time.

- There are cultural differences in preference for face-to-face and email correspondence among members of the global team. This initial finding will be explored further as data collection and analysis continue.
- Group betweenness centrality provides a marker for change in group structure and appropriate time spans for more in-depth analysis.
- Seven "dashboard" measures are promising in initial research findings as accurate indicators of performance in a diffusion network. These metrics are:
    1. *Who is talking*: Who is talking to whom in the collaboration network? What disciplines and organizations do they represent? How far do the networks extend into the organization?
    2. *Champions*: How are they performing? Are they serving as key bridges or liaisons in the network?
    3. *Collaboration*: How strong or weak is it?
    4. *The Buzz*: What is being said about the initiatives (i.e., a new clinical research partnership)?
    5. *Emotion:* How do people feel about the initiatives?
    6. *Rate of Adoption*: How quickly are initiatives being adopted?
    7. *Value*: Are the initiatives adding value as intended?

    These seven metrics will enable organizational members, especially change agents, to understand how collaboration for diffusion is progressing and make adjustments in a timely and targeted way to achieve their objectives.

Challenges and Opportunities:

Challenges include:

- Major executive sponsors have all been replaced due to reorganizations, cutbacks, mergers and acquisitions, forcing us to "re-sell" the project several times in each organization.
- Attorneys in each company had to review and approve research and data collection procedures. Technology transfer offices at both WSU and UIC also had to work with corporate attorneys to protect our universities' rights to commercialization of software.
- The complexity of IT infrastructures and resource constraints in each corporation have necessitated time-consuming workarounds and software development.

Technical opportunities include:

We have discovered, developed and implemented several new technologies to enhance data collection, analysis, and reporting:

- *Condor* is a dynamic social network visualizer that displays both structure and message content in diffusion networks, developed by Peter Gloor and collaborators at MIT
- *Multinet/Negopy* analyzes and displays naturally occurring groups and structural and attribute data together. We have worked with developers Bill Richards and Andrew Seary at Simon Fraser University to merge and modify these two programs to analyze and display large data sets.
- *WordLink* and related *WORDij* tools (developed by Dr. Danowski) have been enhanced to handle large data sets, add new options for analysis, and a Graphical User Interface (GUI) and cross-platform functionality. We are using this software to analyze message content and test differences in content at various points in time.
- *Microsoft Outlook Comm-Add-In* was developed to send both carbon copies and blind carbon copies of email messages to a dummy email box based upon keyword selection and sensitivity levels of incoming and outgoing email. This provided an automatic and targeted method to collect email among global team members.
- *Conversion Utilities* were developed to convert Collexis co-author maps to Multinet node and link files to enable analysis of co-author networks at the institutional level.

New collaboration opportunities include:

- We have joined a global (Germany, Finland, Italy, Canada, Switzerland, South Korea, and several U.S. locations) collaboration innovation network (COIN) studying innovation in social networks. We share ideas, tools, research results and challenges in a global monthly online meeting.
- Visteon Corporation's Environmental Health and Safety Department has been added as a research site to investigate the diffusion of environmental health and safety innovations and new sustainability components across their global network of sixty plants. This includes Ph.D. dissertation research by Tara A. Eaton investigating IT outsourcing to India.
- The Southeast Michigan Center for Medical Education (SEMCEME) was added as research site during 2007-2008. SEMCME is the largest community based medical education consortium in the Midwest (www.semcme.org). We tested the use of our metrics on historical documents to examine changes in topics and leadership and the impact of these changes on educational performance.
- Faculty and graduate students from The Savannah College of Art and Design, Savannah Georgia are currently collaborating with our research team to investigate potential dashboard designs and to provide consultation on the dashboard design from a cognitive perspective.
- An international educational university collaboration among the Massachusetts Institute of Technology, USA, Helsinki University of Technology, Finland, the University of Cologne, Germany, The Savannah College of Art and Design, USA, and Wayne State University, USA will study the relationship of cultural characteristics (such as cultural intelligence, biculturalism and cultural values), work practices (such as global teaming), and social network characteristics as they emerge in online collaboration. There are four instruments:
    1. Biculturalism and cultural intelligence instrument, developed by Dave Thomas at Simon Fraser University in Vancouver, BC and Mary Yoko Brannen, at San Jose State University
    2. Diversity Icebreaker, developed by Bjorn Ekelund, of Human Factors in Oslo, Norway, a typology of personality/communication.
    3. Cultural Perspectives Questionnaire, developed by Martha Maznevski and Joe DiStefano of IMD, Switzerland to measure cultural values
    4. Global Teaming Assessment Instrument, developed by Julia Gluesing and Ken Riopelle to measure team processes and performance.

New research opportunities:

- We contributed a proposal section on Group Dynamics to the Wayne State University School of Medicine five year grant submission in June of 2008 (proposal U54 RR 025893, Diamond (PI), 03/01/09-02/28/14, WSU-HFHS Detroit Regional Institute for Clinical and Translational Research (DRICTR). The Wayne State University (WSU) – Henry Ford Health System (HFHS) Detroit Regional Institute for Clinical and Translational Research (DRICTR) was initiated to dramatically transformation related investigators' capacity to collaboratively conduct interdisciplinary clinical and translational research.). We transferred the lessons learned from our NSF research on automotive companies to propose new research on medical collaboration networks and the diffusion of new practices, devices and drugs to the regional medical community.

New technology transfer opportunities:

- Our team and the Wayne State University Technology Transfer Office is in discussion with Collexis to create an enhancement to Collexis products and services using the tools developed in this grant to analyze co-authorship networks. The initial domain for analysis is medical research. However, there is discussion about expanding the methodology to Thomson's Web of Science.

Project Title: Economic Development and Intergenerational Relations in the Tibet Autonomous Region of China

Proposal Number: 0527500

HSD Emphasis Area: Agents of Change

Lead PI: Melvyn C. Goldstein, Case Western Reserve University
Co-PIs: Geoff Childs, Washington University in St. Louis
International Partners: Tibetan Academy of Social Sciences

Project Goals:

- To investigate how the same set of development forces in a given area impact different rural elderly in different ways.
- To examine the strategies that the elderly, as actors, undertake toward the goal of assuring old-age care from family members.
- To understand the social dynamics underlying how Third World rural elderly deal with family and intergenerational support networks under conditions of rapid socio-economic change.

Thematic Areas:

- Aging and Modernization Theory
- Inter-generational relations
- Social and economic development

Methodologies:

- Social, economic, and demographic surveys
- Functional assessments of the elderly
- Semi-structured interviewing

Recent Research Findings:

To date, we have published one paper from this project titled “Going for Income” in Village Tibet: A Longitudinal Analysis of Change and Adaptation, 1997–2007 (*Asian Survey* 48:514-534). In this, we document a major paradigm shift that has occurred in our fieldwork area from a predominately subsistence agricultural economy to a new mixed economy in which non-farm income plays a dominant role. In response to major infrastructural developments in Tibet as part of China’s “Develop the West” strategy, families in our fieldwork area are sending an increasing number of sons and daughters outside the villages to earn cash incomes. In addition, they are upgrading the skills of family members by apprenticing them as skilled workers (carpenters, masons, painters) so that they can earn higher wages. Some families, notably the more wealthy ones, are investing in tractors, trucks, and earth moving equipment in order to maximize their incomes. A significant outcome of these processes has been an income explosion in rural Tibet. In two of our research villages per household cash incomes rose by 520% and 983% respectively between 1997 and 2005.

The paradigm shift is having impacts, both positive and negative, on intergenerational relations and care for the elderly. On the positive side, in our wealthiest village people have more disposable income that they can give to elderly family members. With cash in hand, old folks are freer to go on pilgrimage, attend social outings, and obtain health care services. We hypothesize that this is a factor that helps explain why the elderly in our wealthiest village seem to be adjusting better to rapid social and economic changes than the elderly in our poorer villages. At this point our data analysis has not been completed, so it is too early to say whether the hypothesis holds true.

One potential concern relates to the consequences of declining fertility. We have documented that, in our research sites, fertility declined rapidly from over six births per woman in the mid 1980s to around two births per woman today. The result of this lower fertility has been a marked decrease in the size of the youngest cohorts. As these smaller cohorts become adults, this will begin to reduce household sizes and effective labor forces, creating a situation where heads of households will have fewer working age members to manage. This will exacerbate the current farm labor shortages caused by so many young adults going out for income, creating difficult decisions for parents. For example, today it is common for families to have three children at home. They are therefore able to choose one or two sons to send for income and another son to stay at home to farm. However, in the not so distant future, parents may find themselves having to choose between keeping their only son at home to farm or sending him for income. It may also increase the farm labor burden on the elderly because there will be fewer capable adults in residence to perform essential agrarian chores. These types of future-oriented decisions are something we are continuing to investigate.

We are currently preparing a paper for journal submission in which we document a new state-level initiative to directly improve the income and quality of life of village households. In particular, we document a subsidy that allows farming families to upgrade their houses, as well as chicken and sheep rearing programs that are designed to enable villagers to generate income by producing meat for urban markets. The relevance to our main research questions regarding intergenerational relations is that the projects are essentially extensions of rural domestic activities. Because many young people leave the village for wage labor while the elderly remain at home, the elderly are now in a position to make contributions to the household's income by raising goats and chickens within the village. We hypothesize that, if the projects prove successful, they can help elevate the status of the elderly. We intend to investigate this issue further during our next stint of fieldwork.

Challenges and Opportunities:
Working in China's Tibet Autonomous Region entails multiple challenges. In 2006 and 2007 we were granted full access to our fieldwork sites and thus were able to collect a substantial amount of data through surveys and indepth interviews. However, in 2008 the unsettled political situation in Tibet resulted in us not receiving permission to conduct fieldwork this year. We are confident that the situation will become normal next year so that we can complete the fieldwork phases of this project.

Other challenges include the usual issue of data reliability. In our initial survey we encountered numerous anomalies and discrepancies, especially regarding household incomes. We overcame this through a triangulation strategy that involved interviewing village leaders and other knowledgeable people about potential sources of income that a household may have neglected to report, and then interviewing people from the household in question to collect more details and fill in gaps. Through this we substantially improved the quality of our background data set.

Regarding opportunities, PI Goldstein had collected data from two of our villages in 1998, thereby providing us with longitudinal data to empirically document the scale of changes that are occurring. In order to document the continuation of the development trends we are now in position to gather similar data at a third point in time, 2009, thereby giving us the best longitudinal data set on rural life that exists for Tibet. Furthermore, by repeatedly interviewing members of certain families over the course of several years (2006-2009) we are able to document the processes through which inter-generational relations are negotiated, and the consequences from one year to the next of decisions that families make. Combined, these indicators of change provide us with an ideal opportunity to address the central question of our project, namely, how do the elderly act as agents of change in response to a continually shifting social and economic environment? We are confident of being in a good position to address this question once the final phase of fieldwork has been completed next year.

Project Title: Evidentiality and Epistemology in English, Navajo and Tibetan

Proposal Number: 0527509

HSD Emphasis Area: Dynamics of Human Behavior

Lead PI: Margaret Speas (University of Massachusetts)
Co-PIs: Tom Roeper (University of Massachusetts) Jill deVilliers (Smith College), Jay Garfield (Smith College), Evangeline Parsons-Yazzie (Northern Arizona University)

The goal of our project is to study how language is related to humans' ability to take the perspective of others and to understand varying epistemic attitudes. In particular, we are examining different ways that languages express mental processes and epistemological attitude. Some languages (such as English) use syntactic embedding under a verb such as 'think', 'know', 'infer' 'conjecture', etc. to express mental processes or attitudes, while other languages (such as Tibetan and Navajo) use non-embedding particles or verbal suffixes. Regardless of the syntactic mechanisms used, understanding expressions denoting mental processes and attitudes requires an understanding of switches in perspective and other minds. In our project we have been using language acquisition experiments and recent advances in the study of linguistic embedding as a window into the triggers for the development of the understanding of other minds.

In our field work on Navajo and Tibetan, we have found that previous studies gave a quite superficial analysis of the syntactic properties of languages that seem to differ from English. For Navajo, we have found that constructions expressing perspective switches and deixis are more systematic than previously described. This information allowed us to provide simple explanation of some of these phenomena that were used in a new Navajo language textbook, which will help Navajo young people carry on their linguistic traditions. In our work on Tibetan, we have developed a theory of the meaning of certain non-embedding particles (called "Evidentials") that captures how they resemble and differ from related constructions.

Our field work feeds the goal of our work in language acquisition, which is to illuminate the path of development of children's knowledge of language expressing mental processes and their understanding of false beliefs and other minds. After having trained a team of Tibetan-speaking associates in India, we are carrying out a series of experiments on the relationship between Tibetan children's acquisition of Evidential particles and the development of their understanding of the concepts of inference and point of view. We have found that the mastery of Evidentials is not directly connected to the mastery of Theory of Mind, although metalinguistic understanding of the more subtle distinctions among Evidentials of inference is strongly correlated with appropriate expressive use. In addition, expressive use is strongly correlated with general linguistic sophistication. We have also found interesting correlations between mastery of Evidentials and the development of inferential ability, as well as a correlation between mastery of the grammar of 'say' complements and mastery of Theory of Mind tasks, which indicates that although Tibetan often uses Evidentials instead of sentential embedding, the development of Theory of Mind is more closely related to sentential embedding than to mastery of the concepts of inference and evidence source.

Our results have led us to posit that children go through a series of stages in learning the syntax and semantics of the Tibetan evidential system:
i) The child takes the marker of visual witness evidence (*'dug*) to mark "here-and-now visible to both speaker and listener," without understanding that it encodes the *speaker's* evidence source.
ii) The child takes *'dug* to mean speaker egophoric certainty.
iii) The child begins using the two Evidentials of indirect (inferential) evidence (*yod kyi red)* and *yod sa red* but does not differentiate their meanings, and takes them to mean "less certain" rather than "indirect evidence."
iv) The child realizes that *'dug* and *yod kyi red/yod sa red* are Evidentials,
marking direct vs. indirect speaker source of evidence, but still cannot differentiate between the

two different indirect Evidentials.
v) The child distinguishes among types of indirect evidence.

It thus appears that although uses of Evidentials can be found quite early in the speech of Tibetan-speaking children, the understanding of the complete evidential system in Tibetan is a late stage in general linguistic development, requiring linguistic sophistication, metalinguistic capacity, metacognitive reasoning, and a mature understanding of the nature of inference.

Selected Publications

Davis, Chris, Chris Potts and Peggy Speas. 2007. 'The Pragmatic Values of Evidential Sentences.' presented at SALT, to appear in conference proceedings; available at semanticsarchive.net http://semanticsarchive.net

deVilliers, J., J. Garfield, M. Kravitz, N. Norbu, C. Slyuter, M. Speas and T. Topgyal, (submitted) 'Who knows what and how? New Evidence about the Acquisition of Evidentials in Tibetan' submitted to *Language Learning and Development.*

de Villiers, J.G. 2007. The interface of language and theory of mind. *Lingua*, 117 (11), p.1858-1878, Nov 2007.

de Villiers, J.G., Roeper, T., Bland-Stewart, L. & Pearson, B (in press) Answering hard questions: wh-movement across dialects and disorder. *Journal of Applied Psycholinguistics.*

de Villiers, J.G. & de Villiers, P.A. (submitted) Complements enable false belief reasoning: The evolution of a theory. Chapter for book with Susan Foster-Cohen (ed).

de Villiers, J.G., de Villiers, P.A. & Roeper, T. (submitted) Wh-questions: Moving beyond the first Phase. Special edition of *Lingua* (eds) Celia Jakubowicz & Petra Shultz.

Newton, A. & de Villiers, J.G. 2007 Thinking while talking: adults fail non-verbal false belief reasoning. *Psychological Science*. 18 (7), 574–579

Parsons-Yazzie, Evangeline and Margaret Speas. 2008 *Diné Bizaad Bíhool'aah (Rediscovering the Navajo Language).* Flagstaff: Salina Bookshelf Press.

Roeper, Tom and Anna Verbuk. 2007. "How Pragmatics and Syntax make Principle B work" (submitted: *Language Acquisition*)

Roeper, Tom and Bart Hollebrandse. 2007. "Recursion and Propositional Exclusivity " submitted [*Linguistic Review* Special Issue D. Everett Editor]

Roeper, Tom. 2008. "Minimalist Architecture from an Acquisition Perspective: Behind, Over, and Through Barriers" Otsu Festschrift (2008) ed. T. Sano

Roeper, Tom. Lisa Green and Michael Terry. 2007. "Stable Nodes and Unstable Features: A Principled Account of Variation Within Minimalism" Submitted [*Lingua* volume on York "Formal Approaches to Variation"]

Roeper, Tom.(to appear). The Maximization of Falsifiability: How To Acquire the Logic Implicatures from The Illogic of Experience" Tokyo Conference on Psycholinguistics--Proceedings.

Roeper, Tom.(to appear) "How Language Acquisition Reveals Minimalist Symmetry in the Wh-System") Cambridge Scholars Press (from Phases Conference) Eds. K. Grohmann, P. Phoevos, M. Oiry

Speas, Margaret. (to appear). 'Generalized Functional Heads' in di Sciullo, Anna Maria, ed. Interface Eligibility at the Edge. Benjamins.

Speas, Margaret. (2008) 'On the syntax and semantics of Evidentials' *Language and Linguistics Compass.*

Speas, Margaret. (2008) Review of A. Aikhenvald, *Evidentialty*, in *Lingua.*

Moulton, Keir.(2008). Clausal Complementation and the DOC Paradigm: A Selection-based Approach. presented at North East Linguistic Society 38, University of Ottawa, Canada. October 24th-26th, to appear in proceedings.

Project Title: Infrastructure Change, Human Agency, and Resilience in Social-Ecological Systems

Proposal Number: 0527511

HSD Emphasis Area: Agents of Change

Lead PI: Stephen G. Perz, University of Florida
Co-PIs: Grenville Barnes, University of Florida; Jane Southworth, University of Florida; Graeme Cumming, University of Cape Town
Collaborators: Universidade Federal do Acre (Brazil): Veronica Passos, Karla Rocha, Lucas Araújo Carvalho, Marcos Silveira; Universidad Nacional Amazonica de Madre de Dios (Peru): Omar Burga Mostacero, Hugo Dueñas Linares, Jorge Castillo, Gabriel Alarcón; Universidad Amazonica de Pando: Daniel Rojas, Andronclès Puerta, Dean Kenji, Liliana Cabrera, Floridia Saavedra, Carlos Vaca Mejia, Guido Rojas Vasquez Colomo; Other universities: Jackie Vadjunec (Oklahoma State), Angelica Almeyda (Stanford). Other organizations: Chris Baraloto (UF Affiliate), Elsa Mendoza (Instituto de Pesquisa Ambiental da Amazonia), Julio Rojas and Frank Paul de la Barra (Centro de Investigacion y Preservacion de la Amazonia), Juan Fernando Reyes (Herencia), Foster Brown (Woods Hole Research Center)

Research Goals:

1. Conduct satellite remote sensing of land cover
2. Conduct community-level interviews about local livelihoods
3. Establish botanical plots to observe and monitor plant diversity
4. Data integration for social-ecological modeling

Thematic Areas:

1. Environmental Dynamics
2. Societal, Organizational, and Cultural Dynamics
3. Social, Political, and Economic Dynamics

Methodologies, Challenges, and Research Findings:

1. Acquisition, processing, and mosaicking of Landsat images [Southworth and RS group]
   - Additional Landsat images acquired for 2007, plus additional cloud-free images for previous years (10 total images), in addition to 77 images previously acquired
   - Processing of new Landsat images, spring 2008
   - Processing of previously acquired images for annual time steps, 2001-2006 (complements previous mosaicks for 5-year time steps up to 2005)
   - Application of semi-automated method (developed in-house) to minimize striping artifacts in affected data
   - Application of automated cloud masking methodology (developed in-house) for the exclusion of cloud and shadow from the data
2. Initial remote sensing on LS imagery [Southworth and RS group]
   Conducted preliminary land cover change trajectories and landscape configuration analyses using the land cover classifications. Change trajectories showed variation in land cover conversion across the region by country and can be associated with distance to roads. Though preliminary, results from these analyses provide insight and guidance for ongoing research with more refined land cover classifications.
   - Production of a report for in-country partner universities and decision-makers (governments, NGOs, communities) based on 5-year forest/non-forest trajectory analysis, comparing the three countries in the tri-national frontier, released August 2008
   - Papers on destriping, tri-national comparison of land cover change trajectories, and forest clearing trajectories in Pando underway
3. Processing and initial analysis of community socioeconomic questionnaires implemented in Bolivia and Peru [Barnes, Perz and SE group]

- The socio-economic component includes an initial community-level questionnaire, which will be followed up in a subset of sites with individual-level questionnaires
- Community-level data for numerous sites along road corridors provides information about specific locations while affording region-wide and up-to-date comparisons with information that goes beyond national censuses and other state data
- Focus on community history, infrastructure, market ties, resource use, governance, conflicts, responses to fires and roads and other challenges
- In Pando, Bolivia, field teams visited 37 communities during July-October 2007 and administered community questionnaires to 3 representatives per community (n=111)
- In Madre de Dios, Peru, field teams visited 41 communities during April-October 2007 and administered community questionnaires to 1-3 representatives per community (n=88)
- Partial data entry for Pando and Madre de Dios proceeded in October 2007; preliminary findings presented at the I Simposio BOLPEBRA, Brasileia, Acre, Brasil, 16-17 November 2007
- Full data entry for Pando proceeded during November 2007-January 2008
- Full data entry for Madre de Dios proceeded in October 2007-January 2008
- Data cleaning and refinement of coding schemes for both Pando and Madre de Dios began in February 2008
- Presentation of initial findings at the University of Wisconsin, April 2008; and for SOBER (Brazilian Rural Economics, Administration and Sociology Association) meetings, July 2008
- Production of a report with initial community-level socio-economic results for partner universities and decision-makers (governments, NGOs, communities), released May 2008

4. Approval of project in Brazil, initial implementation [Perz]

- In May 2007, translated proposal and accompanying documents (personnel lists, municipalities where fieldwork would be done, etc.) submitted to Brazil's CNPq (National Research Council)
- For human subjects approval in Brazil, community questionnaire protocol and accompanying documents submitted to UFAC (Federal University of Acre) ethics committee, June 2007; approved in October 2007; human subjects documentation then sent to Brazil's CONEP (National Council on Ethics in Research) in November for review; approved in January 2008
- For botanical collection approval in Brazil, botanical protocol and accompanying documentation submitted electronically to Brazil's IBAMA (Institute for Environment) in July/August 2007; approved in November 2007
- For fieldwork within 100 km of Brazilian frontiers with other countries, documentation of personnel and study sites submitted to Brazil's CDN (National Defense Council) in December 2007; approval in February 2008, but miscommunication with CNPq led to delay of notification until June 2008

5. Initial socio-economic data collection in Brazil [Perz, Barnes, SE group]

- Onset of community-level socio-economic data collection in Brazil, June-August 2008; first phase involved visits to roughly 20 different INCRA (National Institute of Colonization and Agrarian Reform) areas and interviews with community leaders (n=81)
- Additional approvals required to visit IBAMA areas, notably the Chico Mendes Extractive Reserve; translated proposal and accompanying documentation submitted to IBAMA in July 2008; approval pending
- Initial data entry for Acre community data in August 2008; data cleaning underway, September 2008

6. Second phase of socio-economic data collection in Bolivia and Peru [Perz, Barnes, SE group]

- During March-May 2008, review of 2007 fieldwork in Pando, Bolivia and Madre de Dios, Peru
- Review of 2007 community-level data, selection of communities for revisits for household-level surveys in 2008

- Review and modifications to the household-level questionnaire given findings from 2007 data; greater emphasis on shifts in land tenure, connectivity to towns, non-farm productive activities, crime and health
- Revisits planned for 10 communities in Pando (for ~200 household interviews) and 12 communities in Madre de Dios (for ~350 household interviews); community selection based on quota sampling for community diversity and locations along road corridors, distance gradients from regional capitals; household sample sizes determined from estimates of community size; sampling protocol developed in-house to employ association member lists if possible and if not, sampling based on spatial concentration of housing to ensure representation of households near/far from road
- As of September 2008, 7 of 10 communities visited in Pando and ~8 of 12 visited in Madre de Dios
- Community revisits paired with dissemination of selected findings from 2007 to local leaders; in Pando, ~60 posters; in Madre de Dios, ~1000 pamphlets and ~20 posters

7. Botanical protocol implemented in Bolivia, Peru, and Brazil [Baraloto, Cumming, Bot group]

- Objective is to investigate the relationship between a series of dependent variables describing forest structure and natural resources, and independent variables describing 'connectivity'
- Dependent variables include indices of biodiversity of woody plants (Fishers alpha), floristic composition (matrices of species in key functional or economic use groups), and carbon stocks (derived from aboveground biomass estimates)
- Created a database of permanent plots in the region to establish collaborations with other research groups investigating complementary questions
- Modified Gentry transects employed to meet our sampling objectives and to promote regional collaborations
- Target to establish 50 permanent plots in each of the three sides of the tri-national frontier
- Botanical fieldwork in Pando, Bolivia and Madre de Dios, Peru begun in 2007; fieldwork in Acre, Brazil begun in 2008
- As of September 2008, transects n=~20 in Pando, n=~20 in Madre de Dios, and n=~10 in Acre; expectation of roughly 30 in each side by the end of 2008

8. Post-doctoral modeler contracted [Perz, Cumming]

- Initial post-doc contracted for data integration and modeling back out, April 2008; second post-doc, Xanic Rondon, a Peruvian biologist with experience in the Amazon, contracted in August 2008; to begin January 2009

9. Papers, Presentations and Posters

- Development of data sharing and authorship rights protocols for project PIs, graduate students, and partners in October-December 2007
- Meetings at UF in January-February 2008 to list ideas for analysis and potential publications using project data
- Presentations, reports, posters and pamphlets distributed (see above)
- Papers now in production from the RS and SE components; submissions anticipated during Fall 2008

10. Synergistic Activities

- Perz (PI) is Chief of Party for two UF-led USAID consortia, one focused on Acre, and other on Madre de Dios and Pando; both include additional research and capacity-building activities focusing on road impacts
- Development of a networking proposal for the MacDonnell Foundation to strengthen ties among partners and facilitate comparative, region-wide analyses of complex change in the southwestern Amazon; submission anticipated September 2008

Project Title: LL-Map. Language and Location: A Map Annotation Project

Proposal Number: 0527512

HSD Emphasis Area: Dynamics of Human Behavior

Lead PI: Helen Aristar-Dry, Eastern Michigan University
Co-PIs: Anthony Aristar, Eastern Michigan University; Yichun Xie, Eastern Michigan University
International Partners: Östen Dahl, Stockholm University

Project Goals:
LL-MAP (Language and Location: A Map Annotation Project) is an online Geographical Information System (GIS) designed to integrate language information with data from the physical and social sciences. The system will host a comprehensive set of language distribution maps, along with information on language resources, culture, and demographics. It will also include a LL-MAP 'Scholars' Workbench,' whereby linguists can combine data drawn from their own linguistic research with data already existing in the LL-MAP database to produce new language maps. Its main foci are:

- To build the infrastructure for a central map-site for the study of linguistics in a geographical context
- To collect as much geolinguistic data as possible and make it available to the discipline, digitizing it where necessary..
- To provide a basis upon which modeling of human language movement will be possible.

Thematic Areas:
The project originates in a belief that technology which allows integration of disparate data is crucial to scientific advance. The value of linguistic material lies in that it is the avenue of communication between human beings, and thus the means by which cultural objects are transmitted. In this fact, however, lies also the complexity of linguistic data. It is very difficult to put together linguistic signals in a way that makes sense of their context, for they encompass almost all the human experience.

A Geographical Information System is perhaps the most effective way I know to present material like this. All human events, even those which are linguistic, take place at a location. GIS thus has an advantage that other means of dealing with data do not: it makes it possible to integrate disparate bodies of data through their geographical location, providing potential insight into processes of change which few other techniques could offer. It allows users to analyze data at the same time as they visualize it in terms of its spatial coordinates, and this always adds insight to a problem.

An excellent example of this intersection between language, place and culture is a project we have been pursuing in Alaska. In this project, we sent two of our researchers to the Alaskan Native Language Center, where they have extracted the toponyms from around a hundred paper maps which they have analyzed, catalogued, and georegistered. These toponyms do not just define places; they also elucidate linguistic patterns in the languages they are derived from. Thus, the main thematic area of the LLMAp Project is is that:

- Technologies which allow very disparate sets of data to be compared are a key avenue to scientific advance

Methodologies:
- Geographical Information Systems
- Linguistic Analysis

Recent Research Findings:
In order to facilitate the free use of linguistic data in a GIS context, we have built the following facilities:

1. User Facilities:
    a. United States census data visualization. In this we have normalized language data to the ISO 639-3 standard of languages codes, all of which are associated to US FIPS code up to census tract level. This means that, using the interface, it is possible to exactly how many speakers of one of 7000 languages is spoken in any area of the USA.
    b. IPUMS census data. Language data from the IPUMS project (http://usa.ipums.org/usa/), showing the number of speakers in selected areas of the world has been normalized and made available.
    c. Language Search. Using our facilities, it is possible to search for languages by country, providing users with speaker population counts on the country level and allowing them to link to a data browser which provides all information available on any language they are interested in. (See below for the language data browser)
    d. Country Search. This will search for countries where languages are spoken. It allows user to search by the canonical or secondary name of a language, language family, and language code; it also provides the user with a speaker population count on a country level and a link to the language data browser (See below for language data browser)
    e. OLAC search: This allows the user to access the OLAC database of linguistic information (http://www.language-archives.org/) and display a centroid point which, by its size and color, represents the number of resources cataloged in the OLAC database.
    f. Multidisciplinary data browser: Our facilities allow users to search and view geo-encoded data from other physical/social sciences and blend it with linguistic data.
2. Oracle geo-database:
    a. Relational Database: We have designed and instantiated a relational database that stores language and geographical data which tracks and accesses scholarly projects
    b. Project System: We have designed a geo-enabled, searchable system which allows users to manage geolinguistic projects.
    c. Multiple Data Import: We have built a system which supports multiple data import formats (e.g. flat files, spreadsheets, and shape files)
3. Language data browser:
    a. This consolidates the display of all searchable language resources from multiple projects supported by the Institute. Resources include:
        i. All data in the LINGUIST List (http:linguistlist.org) database – book announcements, dissertations, and academic papers
        ii. The OLAC catalog
        iii. The LINGUIST List researchers directory
        iv. Endangered languages lexicon data: a product of the EMELD project (http:emeld.org)
        v. The MultiTree project: information on the genetic classification and relationships of the world's languages.
4. The project browser:
    a. This is a facility to allow scholars to:
        i. Enter/upload language data
        ii. Display an optimized view of scholars language data using any pre-defined projection
5. Map harvesting using WMS (Web Map Service):
    a. This provides a facility to load images from publicly available WMS/ArcIMS servers
    b. It provides a facility which will overlay map layers from multiple sources.

Challenges and Opportunities:
GIS is one of the most complex and difficult technologies to implement in a flexible way. There are GIS interfaces which can be used for generic purposes, but interfaces which juxtapose language and geography are relatively new. It has been a challenge to produce new software which displays linguistic data perspicaciously, and our programmers have had to do extensive rewrites of the existing GIS software.

In addition, most linguistic data has not been available in digital form. We have therefore had to digitize large numbers of maps in order to generate the GIS views we wish to present.

Project Title: Energy, Air Pollution, and Health Inequalities in Accra, Ghana: Understanding the Technological, Social, and Behavioral Determinants

Proposal Number: 0527536

HSD Emphasis Area: Dynamics of Human Behavior

Lead PI: Majid Ezzati (Harvard University)
Other investigators: Samuel Agyei-Mensah (University of Ghana), Allan Hill (Harvard University), Mark Rosenzweig (Yale University), John D. Spengler (Harvard University), and Matt Welsh (Harvard University)
International partners: University of Ghana

Project Goals:

- Measuring the population distribution of exposure to air pollution in Accra
- Estimating the contributions of household energy, ambient sources, and behavior to air pollution exposure
- Estimating the contributions of air pollution exposure to health inequalities

Thematic Areas:

- Air pollution
- Urbanization
- Energy
- Transportation
- Spatial analysis
- Health disparity
- Africa

Methodologies:

- Geo-coded measurement of ambient and household concentrations of multiple pollutants using integrated and continuous monitors
- Spatial and time-series statistical analysis of pollution data to establish between and within neighborhood variation in ambient and household air pollution
- Geo-coded source counts (for biomass, transportation, and other pollution sources) and spatial analysis of source data
- Household survey and survey data analysis, including asset-based approaches to household wealth
- Population-based health risk assessment

Recent Research Findings:

The analysis of data from our pilot study and ongoing analysis of data from the main measurement phase has quantitatively demonstrated that:

- Particle pollution in Accra neighborhoods is comparable to those seen in Asian cities, and substantially higher than standards in high-income countries.
- Traffic sites have similar particle pollution regardless of neighborhood, determined mostly by road capacity and traffic density. However, residential sites that are only a few hundred meters away, have significantly different particle pollution with the highest residential pollution in the low-income and densely polluted neighborhood of James Town / Usher Town (analysis ongoing).
- There are large seasonal variations in particle pollution, which may have large influence from meteorological factors (versus sources) (analysis ongoing).
- The within-day (minute-by-minute) temporal patterns of particle pollution, are relatively similar across days and between sites, especially when stratified as traffic versus residential, regardless of neighborhood. The patterns, and their similarities as well as

heterogeneities, can be related to the combination of source and meteorological factors (analysis ongoing)
- There is an initial indication of contribution from both biomass and traffic sources, and from non-combustion sources such as geological and marine sources (analysis ongoing).

Our integrated multi-country analysis of poverty, environmental and nutritional risks, and health using the project risk assessment methods demonstrated that:
- Complete coverage of interventions that improve child nutrition and provide clean water and sanitation and clean household fuels would achieve 30-48% of the regional gaps towards the Millennium Development Goal (MDG) target on reducing child mortality in Latin America and the Caribbean, South Asia, and sub-Saharan Africa.
- 50% coverage of the same environmental and nutritional interventions, as envisioned by the MDGs, would reduce child mortality by 30-75% more if the interventions are implemented among the poor first, versus among the wealthier households who nonetheless are in need of similar interventions.

Our analysis of disparities in multiple environmental risks (unsafe water and sanitation; indoor air pollution from household solid fuel use; ambient urban air pollution) in Mexico counties using the project risk assessment methods demonstrated that:
- Together, these risk factors caused 10.6% of child deaths in the lowest SES communities (0.9 deaths per 1,000 children), but only 4.0% in communities in the highest SES ones (0.1 per 1,000). In the 50 most-affected *municipios*, these three exposures were responsible for 3.2 deaths per 1000 children and a 10-month loss of life expectancy.
- In Mexico, nationally, urban PM pollution is responsible for more deaths than either indoor air pollution from household solid fuel use or unsafe water and sanitation individually. In contrast, the latter two risk factors, both with known interventions, caused more child deaths nationwide and had disproportionately larger mortality effects in a number of rural and predominantly indigenous communities.

Challenges and Opportunities:
- Logistical issues in field research were enormously magnified since Ghana started having regular electricity outages (due to energy shortages) exactly at the initiation of the main phase of the project.
- Strong community ties established during the project have created an opportunity for extremely detailed empirical research on environmental exposures in various communities in Accra.

Project Title: Spatiotemporal Dimensions of Population Change in the Northern Orkney Islands from About 1735 to 2000

Proposal Number: 0527539

HSD Emphasis Area: Dynamics of Human Behavior

Lead PI: James Wood, Penn State Univeristy
Co-PIs: T. Murtha, PSU; P. Johnson, PSU; S. Mathews, PSU; C. Sparks, UTSA

Project Goals:
The ultimate goal of this project is to understand changes in demography, economy, land use, and settlement in the northern islands of Orkney, Scotland, from c. 1735 to the present. This period witnessed the transition from a traditional system of near-subsistence agriculture and demographic stasis to a modern regime of thoroughly commercialized livestock rearing and demographic decline. To understand these changes, project personnel are working in four areas:

- Family reconstitutions are being done using information on the timing of basic demographic events (births, marriages, deaths) contained in parish records and civil registers. In addition, decennial censuses provide information on population at risk, as well as household composition, location of residence, occupation, and land tenure.
- Other archival documents, including old topographic and cadastral maps, tax valuation rolls, and rentals, are being copied and linked to the households recovered from the family reconstitution analyses. On-ground field surveys of old crofts and farm complexes are being conducted, in which all buildings and walled enclosures are measured and mapped, elevations are drafted, functional components are identified, and building phases are reconstructed. Since the archival information is all categorized by named farmstead, we are readily able to link the sites from the field survey to the demographic and economic information on individual households.
- Ethnographic interviews/oral histories are being collected from all long-term island residents over the age of 60. These interviews provide genealogical and family history information to fill in the gaps resulting from the British law forbidding access to individual-level census information for 100 years after the date of the census. Older residents are also able to provide detailed information on life on some of the old croft complexes when they were still occupied.
- All the information collected in the field and archive are geo-referenced for analysis combined with time series multi-spectral images to better interpret landscape patterns.

Thematic Areas:

- Historical Demography
- GIS/Anthropology/Archaeology
- Spatial and Temporal Dynamics of the Demographic Transition

Methodologies:

- Ethnography/Demography/Settlement Pattern Survey
- Remote Sensing/Landscape GIS
- Spatial Analysis

Recent Research Findings:
By July 2008, almost all the basic demographic data, drawn from prospective vital registers and decennial censuses, were entered in the project databases. (Some vital register material for Sanday needs to be copied in Edinburgh next year.) The demographic data for Westray, Papa Westray, and Faray are completed, and something like 60 percent of the record linkage has been finished for Sanday. All that remain are the comparatively small islands of Eday and North Rondaldsay, and the demographic information is already in hand for both islands.

Preliminary analyses of these data have revealed several unexpected patterns. For example, the secular decline in mortality was quite late in northern Orkney, getting underway only after about 1880. The principal reason for this late start seems to have been the high prevalence of pulmonary tuberculosis, which persisted into the 1920s, albeit with a declining incidence. Northern Orkney may thus represent a rare (perhaps unique?) case in which declining fertility rates preceded the modern decline in death rates.

We have spent considerable time validating one potentially powerful source of econometric data. We have done preliminary analyses using these data on the assumption that these valuations tell us something about the amount and/or quality of land held by each household. Until recently we have had little confidence in the validity of these data, i.e. we've not been sure exactly what these valuations are telling us. As it happens, we have geo-referenced several estate maps from c. 1840-1850, a period that overlaps with the available valuation rolls. A multivariate regression analysis of the combined valuation and estate-map data shows us that rents are almost entirely explained by the main effects of acreage in arable and in pasture, and by the interaction between the two ($R2 = 0.97$, the best fit any of us has ever attained!). We now believe we understand the information from the valuation rolls well enough to use it with confidence.

We have used the valuation rolls as we continue to analyze what we have called 'hidden household extension'. In something like 15 percent of households between 1841 and 1901, several closely-related nuclear families (usually linked through married brothers) occupied adjacent houses and shared infrastructural resources such as barns, byres, grain-drying kilns, kailyards, and stables. Although the archaeological evidence clearly shows that these were functioning as single, integrated multiple-family farming units, the census records and vital registers list them as if they were two or more autonomous nuclear-family households (it is in this sense that extended households are 'hidden' from the conventional historical demographer). This finding, which emerges only when demographic and archaeological data are combined, is surprising because extended households are believed by most historical demographers to have been very rare in early modern Europe. We are currently investigating their demographic and economic dynamics.

Due in part to our field research experiences on Eday and our progress in completing cadastral map referencing, we have begun to explore techniques for using remote sensing to characterize and better quantify landscape patterns related to landuse, land capability, and soil qualities. While this research has only just begun, we have processed LandSAT TM+ imagery and the 1988 aerial photos to better interpret past landuse patterns as observed in these more recent images. For example, we are using LandSAT ETM+ imagery wherein the thermal band (7) has been converted to land surface temperature in an effort to identify spatial and temporal dimensions of fallowing agricultural lands. Additionally these data allow us to quantify peat cuttings and other landscape transformations.

By July, 2008, we completed interviews of all eligible residents (60+ years of age, born in the study area) on the islands of Sanday, Westray, and Papa Westray, as well as the majority of eligible residents on Eday. These interviews illustrate the variation across the northern isles in the areas of economic and social change. They also provide us with the undocumented perspectives of life on the islands during the 20th century demographic decline. Sanday, for example has a quite different recent demographic history from the other islands, experiencing two waves of twentieth century in-migration and a very early arrival of the first migrants. During the late 1960s Sanday saw the beginning of a major influx of immigrants from Scotland and, particularly, from England. The original wave of migrants is unique in the northern isles and demonstrates the effect that relatively small cohorts can have on small and declining local populations. Local residents remark, with obvious resentment, on the failure of many of these in-migrants to do any kind of meaningful work and say that many were being supported by families in the south who, eager to keep their children at a distance, were willing to provide them with allowances that were quite generous by local standards. Reaction to these migrants, seen as well-educated and relatively wealthy, was also colored by the exodus of local young people who could not find work

on Sanday since small farms were no longer economically viable and were being sold to create larger agricultural conglomerates whose mechanization obviated the need for manual labor. While many of these first migrants moved from Sanday after a few years on the island, some remained and have produced a third generation of 'incomers' whose non-local status is still noted in some circumstances. Even children with one local parent and one immigrant parent are sometimes described as not quite local.

By combining traditional historic demographic data with survey, GIS, remote sensing, and ethnography, we are beginning to better understand and interpret the recent history of the north Orkney Islands, from 1735 until today. During that time, these islands witnessed extended population growth (associated with kelp production and export), agricultural improvement (primarily focused on changing the space of agricultural production), a recent and sustained decline in population, and the industrialization of farms. Our project not only will not only investigate the spatial and temporal dynamics of these demographic, social and economic changes, but also offers an innovative interdisciplinary approach for historic demographic research.

Project Title: Ecosystem Services From Low-Input Cropping Systems: Incentives to Produce Them and Value of Consuming Them

Proposal Number: 0527587

HSD Emphasis Area: Agents of Change

Lead PI: Scott M. Swinton, Michigan State University
Co-PIs: Frank Lupi and Philip Robertson
Collaborators: Natalie Rector, Robert Shupp

Project goals:
1: Evaluate feasibility of scaling up from experimental plots to farm fields.
2: Investigate farmers' awareness and perceptions of low-input cropping practices.
3: Estimate farmers' willingness to change to low-input practices in exchange for payments.
4: Estimate citizens' willingness to pay for environmental services from agriculture.

Thematic area:
Agents of Change: Social, Political, and Economic Dynamics

Methodologies (by objective):
1: Scaling up – Farming of 27 farm fields on Kellogg Biological Station (3 rotation entry crops (corn, soybean & wheat) X 3 treatments X 3 field sizes over 3 years).
2: Farmer focus groups (3 groups in each of 2 regions; 39 participants total).
3: Farmer focus groups and mail survey of Michigan corn and soybean farmers (1806 returned surveys in 2008).
4: Mail survey of Michigan taxpayers (scheduled for 2008-09).

Recent research findings:
The focus groups found that farmers 1) are already adopting low-input cropping practices that save labor and/or input costs without reducing revenues, 2) are open to soil testing, pest scouting, and other information-based technologies that can reduce agrochemical input use, and 3) are reluctant to adopt practices that are perceived as having a significant risk of reducing incomes (including planting low-value crops, planting cover crops that can interfere with spring planting of major crops, and reducing agrochemical input levels below currently recommended norms for profitable farming). The farmers believed that the environmental benefits of certain low-input cropping practices, such as reduced global warming, were of greater value to society at large than to themselves. They also doubted whether the proposed changes in their farming practices would be as beneficial as scientists believed (notably the global warming mitigation effect). Preliminary results from the mail survey of farmers (1806 returns from 3000 contacts) suggest that the large sample results are generally consistent with the focus group findings.

Challenges and opportunities:
The returns from the large sample survey of farmers offer the opportunity to quantify and model farmer willingness to supply ecosystem services for a representative sample of farmers; these data analyses continue. The public survey will allow us to compare the public's demand for agricultural ecosystem services with the farmer's willingness to supply, but the development of the public survey requires substantial time to describe the ecosystem service changes to the public in scientifically sound, yet clear terms.

Project Title: Developing a Measure of Voluntary Consent for Protocol-based Treatment Decisions

Proposal Number: 0527618

HSD Emphasis Area: Decision Making, Risk, and Uncertainty

Lead PI: Robert M. Nelson, MD, PhD, The Children's Hospital of Philadelphia
Co-PIs: Mary Frances Luce, PhD, Duke University; Tom Beauchamp, PhD, Georgetown University
Collaborators: William Reynolds, PhD, The Children's Hospital of Philadelphia; Victoria A. Miller, PhD, The Children's Hospital of Philadelphia; Richard Ittenbach, PhD, Cincinnati Children's Hospital Medical Center; Diana Harris, MBe, The Children's Hospital of Philadelphia

Research Goals:

1. To create an item pool that assesses all major dimensions of decision making control for this sample of parents.
2. To construct a voluntary consent scale (DMCI) appropriate for use with these parents.
3. To examine the relationship between DMCI total score and selected measures of decision-making preference, coping style and affect.

Thematic Areas:

1. Risk perception
2. Decision making
3. Voluntary choice

Methodologies:

1. Qualitative: Focus groups and semi-structured interviews with parents, physician-researchers, and other research professionals to elicit their views of voluntary decision making to ensure that all aspects of voluntariness are included in the DMCI item pool.
2. Quantitative: a) Common statistical techniques for scale development including principal components analysis, exploratory factor analysis, and confirmatory factor analysis. b) Linear regression to establish causal relationships between DMCI and measures of affect, decision making and information preference, and other variables.

Recent Research Findings:

Participants in this study were parents who had made a recent decision to enroll a child in a protocol-based treatment, which typically meant a clinical trial or other clinical research protocol. Parents gave informed consent for participation in this study within a timeframe of one to ten days of making this decision. A total of 231 parents were enrolled. Ten subjects were excluded from data analysis primarily because study instruments were not completed or returned within the 10-day decision window (e.g., they took the survey packet home and didn't return it within ten days). Of 221 evaluable cases, nearly 75 percent of the sample is female, 68 percent white, 21 percent black, and 10 percent "other." Over 26 percent of respondents have at least a college education, about 75 percent are married, and a little more than 50 percent of the sample reported a 2005 household income of $60,000 or greater. Among the 81 percent of participants who made a decision "jointly," 67 percent made this decision with their "spouse", with their physician being cited second most frequently (nearly 31 percent). Only 12 participants (five percent) delegated the decision to someone else (either to a spouse/partner or physician), and 93 percent agreed that their enrollment decision was voluntary on a single item question of voluntary decision-making. Half of the sample agreed and half disagreed with the statement, "even though it was my choice, I had no choice." Most participants completed the survey between 0-5 days of having made a decision, while 28 percent-29 percent completed the packet within 6-10 days. Thirty-seven subjects either refused to participate in this study or withdrew after providing consent.

Using methods that included principal components analysis, exploratory factor analysis, and maximum likelihood factor analysis, we have completed scale construction (Aim 2). From an initial pool of 28 items, we derived a 9-item 3-factor solution for the final decision-making control scale (or DMCI). Factors 1 and 2 each had items with standardized regression coefficients (i.e., factor "loadings") greater than .40. One item in Factor 3 has a coefficient slightly below .40, but this item was retained on conceptual grounds. (Item labels preceded by the letter "R" indicate reverse scoring.)

Factor 1 represents a latent construct of decision making control we have labeled "self control," and consists of the following three items:

- I made this decision (VC6).
- I was not the one to choose (RVC28).
- The decision was up to me (VC34).

Factor 2 represents a latent construct we have labeled "no control" and is made up of the following items:

- I was powerless in the face of this decision(RVC2)
- I was not in control of this decision(RVC24)
- I was passive in the face of this decision(RVC19)

Factor 3 represents a latent construct we have labeled "others' control" and is made up of the following items:

- Others made this decision against my wishes(RVC26)
- The decision about the protocol was inappropriately influenced by others(RVC22)
- Someone took this decision away from me(RVC3)

We are currently addressing Aim 3 of the project, which involves construct validation of the DMCI and analysis of associations between the DMCI and other study instruments. Based on the results of a preliminary analysis that focused on testing hypotheses of associations between the DMCI and related measures, we have identified several models that will undergo further analysis. For example, early analyses of the relationships among coping, mood, decision making involvement and trust suggest that individually or in combination these may impact one's perceptions of decision making control (i.e., scores on the DMCI). Specifically, four models that warrant further exploration and analysis include:

- Coping (emotion-oriented subscale) as a moderator of the relationship between the Krantz Health Opinion Survey (KHOS) and DMCI.
- Trust in Physician (TPS) as a moderator of the relationship between the KHOS and DMCI.
- Coping (task-oriented subscale) as a moderator of the relationship between Composed/Anxious (Profile of Mood States, Subscale A) and DMCI.
- Coping (task-oriented subscale) as a moderator of the relationship between Elated/Depressed (Profile of Mood States, Subscale C) and DMCI.

Challenges and Opportunities:

An early challenge of this project involved recruitment of parents who had recently made decisions about enrolling children in protocol-based treatments. Meeting this recruitment challenge (221 evaluable cases) has provided us with a unique opportunity: to interview parents within a very short time (i.e., one to 10 days) of their having made what for many is a difficult and emotion-laden decision. Much of the empirical research on informed consent and research participation decision making involves small numbers of subjects who are reflecting upon decisions made well in the past. We have a large data set with measures completed during a period when the participation decision was quite fresh.

With the scale construction phase of the project (Aim 2) complete, we have the opportunity to assess the association between voluntary decision-making and a number of variables related to affect and decision making (Aim 3). Variables such as affect, coping, trust in physicians and

researchers, information and decision making preference, and self-efficacy have rarely been evaluated in studies related to research participation (or clinical) decision making. We anticipate that our findings will represent a significant contribution to our understanding of parent decision making in the context of protocol-based treatment.

Project Title: Paleoclimatic Change, Landscape Evolution, and Cultural Transformations in Far Western Tibet, 2500 BP-Present

Proposal Number: 0527620

HSD Emphasis Area: Agents of Change

Lead PI: Mark Aldenderfer, University of Arizona
Co-PIs: Jonathan Overpeck, Kam-biu Liu, Julie Cole, Jon Pelletier, Wang Luo, Houyuan Lu
International Partners: Louisiana State University, Institute of Geology, Chinese Academy of Sciences

Project Goals:

- What were the timing, spatial scale, duration, and intensity of the Indian Summer Monsoon variations in the past? How did seasonal mean change relate to changes in variability and extremes? Answering these question will help to determine if the monsoon changes exacerbated already existing political problems (intensive factional competition) or created the context for their emergence. This work will also test the hypothesis that the monsoon is now intensifying in the drier reaches of the SW Asian Monsoon – a trend that could indicate more change to come.
- What effects did the monsoon have upon fluvial and alluvial evolution in the upper Sutlej River of far western Tibet? Did increasing dessication lead to higher erosional potential and arroyo cutting? Were these changes linear, non-linear, and/or potentially predictable? How long did these land-altering changes persist? Were there reductions in the amount of arable land, and how large were these reductions?
- What impacts did changes in the monsoon have on the vegetation of the region? Were changes gradual or abrupt? Were they predictable, and how long did climate-induced changes persist? How might these changes have altered the amount and quality of range suitable for grazing?
- How did climate, vegetation, and human land-use interact to affect both fluvial/alluvial (i.e., irrigated farmland) and range systems in far western Tibet? Were monsoon changes synchronous with changes in vegetation and landscape character, and to what extent did humans aggravate or mitigate the impacts of climate and vegetation change?
- How did people in far western Tibet cope with abrupt climate change?

Thematic Areas:

- Human response to abrupt climate change
- Landscape evolution in arid environments
- Paleoclimatic reconstruction

Methodologies:

- Archaeological survey and limited excavation
- Geomorphological analysis of terraces, spring systems, and fluvial dynamics of the major drainages of far western Tibet
- Limnology, including studies of lake geochemistry, palynology, phytolith analysis, and ancillary studies

Recent Research Findings:

1) What is the cause of widespread hillslope and alluvial fan entrenchment in south-central Tibet?
One of the most exciting discoveries of the trip was the observation that hillslope and alluvial fans are deeply dissected in lowland south-central Tibet, particularly along the Yarlung-Tsangpo and Lhasa Valleys between Saga to the west and Lhasa to the east. Although this problem is not directly related to the grant (i.e. the cause of population crashes in western Tibet), it does have important implications for paleoanthropology in Tibet because the cause of the incision appears to be widespread overgrazing within the last several thousand years. In locations with thick

regolith and loess cover, hillslopes, and alluvial fans adjacent to valley floors are deeply rilled and dissected. The incision appears to be several thousand years old at nost based on the narrow, vertical-walled channels. In areas of thin regolith and loess cover, shallow landsliding has removed the cover locally (like dead skin sloughing off after a sunburn), leaving a thin, discontinuous layer. What is remarkable about the incision is the enormous extent of the area affected by it. Although it's possible that the incision has many different causes (tectonics in some places, climate or land-use changes in others), the continuity of the incision across nearly a thousand kilometers and the similarity in incision morphology from one drainage basin to the other strongly suggests a single regional triggering mechanism. Near Shigatze where the incision is most intense, drainage basins with areas ~ 10 km^2 are incised 10-20 m deep. The incision is typically lenticular in shape, increasing from the channel head downslope to the top of the alluvial fan, then decreasing in depth down the alluvial fan. The incisions typically expose several (and up to as many as 10) well-developed paleosols. These paleosols indicate that prior to incision, the hillslopes and alluvial fans were characterized by deposition and stability throughout most of the late Quaternary. Therefore, this incision event appears to be unprecedented within that time period.

To date the incision, we sampled 10 deposits for OSL dating at 5 type locations (no datable organic material was found in any location). Each OSL pair is designed to bracket the incision using the highest (youngest) sediments of the incised terrace and the lowest (oldest) sediments of the inset terrace. In most cases, the inset terrace is composed of sediments reworked during the incision event. Therefore, the date of the incised terrace is likely to the closer of the two dates to the actual incision event. We believe that dating the incision using paired stratigraphic dates represents the only way of dating this event. There is also a close correspondence between the incised terrace and redware ceramics in 4 out of the 5 locations we studied. Given that our study sites were chosen more or less at random covering a distance of at least 500 km, there is clearly a great deal of redware pottery in south-central Tibet. At 1 of the 5 study sites, ceramics were found in situ in sediments just beneath the incised terrace, indicating that site occupation preceded landscape incision. At the other locations where ceramics were found, ceramics were only found scattered on the surface. These sites provide no clear information on the timing of occupation, because surface scatter could . In most cases we favor the idea that occupation preceded incision. Four possible mechanisms exist for triggering this landscape change: tectonic uplift, climatic change (by "direct" changes in runoff intensity or "indirect" changes in hillslope vegetation cover), complex response (i.e. autocyclic geomorphic processes), or human activity. Future geochronological and modeling work will identify the likely cause of the triggering mechanism.

2) What is the history of arroyo cutting of the Sutlej River in the Kyunglung area and its relationship to habitability?
Detailed sedimentological and stratigraphic analyses were performed along two sections of tributaries to the Sutlej River near Kyunglung Mesa. Field relationships indicate that the Sutlej River has abruptly incised at least three times in the Holocene. The stratigraphy illustrated below indicates the following history: river aggradation to deposit unit D, arroyo cutting, river aggradation to deposit unit C, arroyo cutting, deposition of unit B, and finally coarse-grained deposition of unit A before late-Holocene arroyo cutting to expose the stratigraphy. These arroyo cutting events led to rapid water-table drop and loss of arable land along newly abandoned terraces. Geochronology will determine whether these arroyo cutting events correlate with population declines.

3) What is the Pleistocene-Holocene downcutting history of the Sutlej River and its relationship to spring levels and habitability in the Guge area?
The Sutlej River has a remarkable sequence of 9 Pleistocene-Holocene terraces in the area near Guge and Kyunglung. Preliminary field work indicates that the rate of incision near Guge is approximately 3 mm/yr. In the 700 yr since the decline of Guge approx. 700 ybp, that implies a total river incision of about 2.5 m.

Unlike Kyunglung, villages near Guge relied heavily on spring discharge. For example, the figure at the (lower right) shows a spring-fed irrigation canal. The spring that fed that canal is currently lower than the canal by 2.5 m. This amount of spring lowering corresponds precisely to the amount of downcutting of the Sutlej River in the last 700 yr. Spring lowering has led to the migration of a headcut through the valley, suggesting that the spring lowering was abrupt and led to catastrophic changes in the fluvial system. Future work in this area will precisely quantify the downcutting rate of the Sutlej and its relationship to spring elevations.

Challenges and Opportunities:
The primary challenge faced by the project is the unstable political situation in Tibet. Permits for continued work are being solicited, but delays in receiving permission for the final stages of the archaeological research are inevitable. We are currently investigating the use of remotely sensed data (high resolution satellite images) to define abandoned field systems, villages, and other features that are likely to date to the period under examination.

Project Title: Dynamic Modeling of System Safety to Manage Risk and Enable Internal and External Cross-Stakeholder Alignment

Proposal Number: 0527660

HSD Emphasis Area: Decision Making, Risk, and Uncertainty

Lead PI: Prof. Nancy Leveson, MIT
Co-PIs: Prof. John Carroll, Dr. Joel Cutcher-Gershenfeld, MIT
Other Government Agency Participation: NASA headquarters (the Shuttle Operations Mission and the Exploration Systems Mission Directorate) participated in the experiments and allowed us to demonstrate our risk analysis and management techniques on their programs and management structures.

Project Goals:

- Develop a new theoretic model of causality to be used in risk analysis and management of socio-technical systems. The causality model is based on system theory
- Develop modeling techniques and tools based on the theoretical foundation
- Validate the new approach by applying it to the NASA space exploration mission and air transportation security.

Thematic Areas:

- Causality and risk in complex, socio-technical systems
- Risk modeling and analysis
- Stakeholder alignment in high-risk projects

Methodologies:

- Systems theory
- New static and dynamic modeling and analysis techniques
- Protocol-based interviewing

Recent Research Findings:
A new causality model based on systems theory has been developed and formal modeling and analysis tools defined and prototyped. We have demonstrated the feasibility and practicality of the new risk analysis and risk management approach based on our more sophisticated causality model by applying it to the two example social systems: space exploration and air transportation security. The two NASA models, both of which contain hundreds of variables, were created and used for two different types of risk analyses. The first was a risk analysis on a new management/organizational structure in the NASA Space Shuttle program. We were able to outperform a standard programmatic risk analysis that was accomplished in parallel by experts at NASA. In the process we identified gaps and omissions in the new organizational design and we identified changes that would reduce risk significantly. In addition, we were able to identify leading indicators of risk that can be used by NASA to detect the migration toward the states of unacceptable risk that preceded both of the Space Shuttle losses (Challenger and Columbia).

The second NASA risk analysis was performed on the new manned space exploration mission (return to the Moon and then on to Mars) and was the basis for our enhancing our basic risk analysis approach to allow comparing and evaluating tradeoffs among different types of risks including safety, performance, budget, and schedule risks. Our experimental analysis includes the entire socio-technical system from Congress and the Executive Branch down to engineering processes and management. In this effort we found, for example, that attempting to speed up development of the Shuttle replacement resulted in surprisingly little improvement in schedule (less than 2 percent) primarily because of resulting increases in rework, but the attempted schedule reduction had a very high negative impact on the safety of the resulting design. At the same time, early emphasis on safety led to improvements in both schedule and budget due,

again, to fewer required changes and rework when problems are discovered late. This result was a surprise to the NASA program managers involved and provided, in addition, a mathematical analysis of the differences and rationale. As another example, this one in the area of workforce planning, our analysis showed that the development of the Space Shuttle replacement (called Orion) will not be possible within the time frame planned (2012 at the time of the study) unless Congress relaxes hiring constraints on NASA. The timetable has since been changed.

Because the models are so large, validation becomes an important issue. A validation methodology for the models was created that includes testing and formal reviews by experts using protocol-based interviews. We have experimented with the protocol-based approach in interviews with 45 NASA employees, using them not only to validate our models but to elicit risk information and stakeholder alignment data.

Challenges and Opportunities:
We have few challenges and, in fact, have accomplished more than we originally proposed. As a result we are tackling a new opportunity this year in the form of modeling and analyzing the complex socio-technical system involved in pharmaceutical development. Drug safety and access issues (including economic factors) are a major problem in society today. Many proposals have been made for improving the pharmaceutical development and distribution system, but there is no way to evaluate them or to determine whether there are potential unwanted side effects. We are working on determining whether our risk modeling and analysis can be applied to this problem to evaluate proposed policy and other changes to reduce pharmaceutical risk and improve access. At the same time, we hope to be able to identify potential unexpected negative impacts. All too often, well intentioned efforts to solve pressing problems create unanticipated side effects: today's solutions simply become tomorrow's problems.

Project Title: From Where to What: The Dynamics of Spatial Cognition

Proposal Number: 0527698

HSD Emphasis Area: Dynamics of Human Behavior

Lead PI: John P. Spencer, University of Iowa
Co-PIs: Gregor Schöner, Ruhr University, Bochum, Germany; Steve Luck, UC Davis

Research Goals:

1. To explain how the brain integrates 'what' and 'where' information to form a unified map of objects in a local workspace
2. To develop a theoretical framework for understanding how visuo-spatial cognition evolves in real time and over learning in a task-specific manner
3. To empirically test our new theory using behavioral experiments with adults

Thematic Areas:

1. Spatial Cognition
2. Working Memory
3. Theoretical Neuroscience

Methodologies:
We combine behavioral research with adult participants with dynamical systems/neural network modeling.

Recent Research Findings:
We have now quantitatively modeled two novel empirical findings: (1) people are actually BETTER at remembering the details of similar objects; and (2) objects held in working memory can "drift" over short delays such that people exaggerate the difference between the two objects.

In addition, we found that long-term memories for object features are bound to their spatial positions such that objects that are close in space and similar in features "blend" together early in learning.

Finally, we have demonstrated that measures of visual working memory capacity provide a limited window into the working memory processes that underlie performance in standard tasks. For instance, our empirical and modeling work suggests that standard formulas for computing capacity do not accurately explain the sources of error in tasks that ask people to detect changes in objects. Moreover, such formulas underestimate the number of working memory representations that can be simultaneously maintained under supportive circumstances.

Challenges and Opportunities:
We have implemented a new neural network model that is quite complex. In the past year, we've made dramatic strides on solving some of the computational challenges of running simulations with this network. A key advance was partitioning the convolutions in the equations we are simulating.

Interpersonally, the main challenge has been distance. Dr. Steve Luck is at UC Davis. We have been communicating via video conference plus a visit by Dr. Luck to Iowa this past summer. We have also been working closely with Dr. Schöner's robotics group. We had joint lab meetings between the Germany group and the Iowa group this past year. They were quite successful, although technical challenges were regular and annoying (e.g., slow internet connection, poor video quality at times, trouble sharing files "live", and so on). That said, these lab meetings have brought our groups closer together and spurred several collaborative projects.

We also hosted a Dynamic Field Theory Summer School at Iowa that was preceded by a mini-conference with the Iowa and Germany groups. This was a huge success—it was wonderful to sit face-to-face in the same room—and we will certainly repeat this event next year.

Project Title: Community Risk Management of Hurricane and Tsunami Surge Hazards

Proposal Number: 0527699

HSD Emphasis Area: Decision Making, Risk, and Uncertainty

Lead PI: Michael K. Lindell and Carla S. Prater: Texas A&M University Hazard Reduction & Recovery Center
Collaborators: Harry Yeh and Cherri Pancake, Oregon State University

This project is conducting research on coastal communities' best options for protecting themselves from hurricane and tsunami surge hazards. In the past year, we completed revisions on a multi-stage model of household response to three hazards—flood, hurricane, and toxic chemical release (Lindell & Hwang, 2008). The model, which extends Lindell and Perry's (1992, 2004) *Protective Action Decision Model*, proposed a basic causal chain from hazard proximity through hazard experience and risk perception to expectations of continued residence in the home and adoption of household hazard adjustments. Data from 321 households generally supported the model, but the mediating effects of hazard experience and risk perception were partial rather than complete. In addition, the data suggested four demographic variables—gender, age, income, and ethnicity—affect the basic causal chain at different points.

In a second, task, we completed the final revisions on a community policy process review that has assessed changes in communities' tsunami hazard awareness and emergency preparedness and examined the processes influencing community management of hurricane and tsunami surge hazards (Tang, Lindell, Prater & Brody, 2008). We recently completed analyses of the quality of tsunami hazard management plans from 43 coastal counties in these states. Plan quality was measured by a protocol comprising five components defined by 37 indicators. The results show few Pacific coastal counties have prepared well for tsunamis. Most plans have a weak factual basis, unclear goals and objectives, weak policies, and few coordination and implementation mechanisms. The average plan quality score is 12.25 out of 50 points and ten counties never mentioned tsunami risks in their local plans at all. This evaluation suggests these jurisdictions need to build a solid factual basis about tsunami hazard; set appropriate goals and practical objectives; expand the array of tools used by planners; enhance interdisciplinary and inter-organizational coordination mechanisms; and improve their mechanisms for plan implementation.

A third task completed revisions on a simple, rapid method for calculating evacuation time estimates (ETEs) that is compatible with research findings about evacuees' behavior in hurricanes (Lindell, 2008). This revision of an earlier version of the Empirically Based Large-scale Evacuation time estimate Method (EMBLEM) uses empirical data derived from behavioral surveys and allows local emergency managers to calculate ETEs by specifying four evacuation route system parameters, 16 behavioral parameters, and five evacuation scope/timing parameters. EMBLEM2 is implemented within a menu-driven evacuation management decision support system (EMDSS) that local emergency managers can use to calculate ETEs and conduct sensitivity analyses to examine the effects of plausible variation in the parameters. In addition, they can run EMDSS in real time (less than 10 minutes of run time) to recalculate ETEs while monitoring an approaching hurricane. The article provides and example using EMDSS to calculate ETEs for San Patricio County Texas and discusses directions for further improvements of the model.

A fourth task examined the degree to which the use of the Incident Command System (ICS) influenced the performance of Texas EOCs during Hurricane Rita (Lutz & Lindell, 2008). Staff in evacuation and host county EOCs completed a questionnaire that assessed demographic variables, EOC physical conditions, ICS experience, ICS implementation, and team climate. The results indicated that the duties each ICS section performed varied substantially from one EOC to another. Moreover, ICS experience and ICS implementation did not have statistically significant correlations with team climate, even though EOCs' physical environments did. Thus, there needs

to be further study of ICS application in non-fire emergencies, as well as the development of new ICS training materials for *emergency relevant* agencies to supplement the current ICS training materials for *emergency mission* agencies

A fifth task involved a longitudinal study of the degree to which local governments and households learn from flood risks and under what conditions (Zahran et al., 2008). We addressed this research gap by analyzing household flood insurance purchases in Florida from 1999 to 2005, and the extent to which household insurance purchases corresponded with flood mitigation activities by local governments involved in the Federal Emergency Management Agency's (FEMA) Community Rating System (CRS). Regression results indicated that household flood insurance purchases correlate strongly with local government mitigation activities, adjusting for hydrologic conditions, flood disaster histories, and community demography. Policy implications of this observed relationship were discussed, assuming four temporal order and floodplain development scenarios.

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Project Title: Global State Formation: Modeling the Rise, Fall and Upward Sweeps of Large Polities in World History and the Global Future

Proposal Number: 0527720

HSD Emphasis Area: Agents of Change

Lead PI: Christopher Chase-Dunn, Institute for Research on World-Systems, University of California-Riverside
Co-PIs: Peter Turchin, University of Connecticutt and E.N. Anderson, University of Caliifornia-Riverside

Recent Research Findings:
Patterns of expanding state formation constitute a long-term evolutionary trend that may eventually result in the emergence of a single world state. The very nature of the expansion of political integration has itself evolved because new institutions that facilitate and organize regional integration, cooperation and conflict have emerged. Military conquest and the long-term interaction between sedentary agrarian empires and confederations of pastoral nomads came eventually to be replaced by a process of geopolitical and economic competition among states in a world that has increasingly been integrated by market exchange. In the last 200 years international governmental and transnational non-governmental organizations have emerged that constitute the first beginnings of world state formation, and the national states have been partially reconfigured as instruments of an increasingly integrated global capitalist elite. World state formation may be desirable because the problems created by human technological and social change are increasingly global in scope. But a world state will need to be legitimated in the eyes of a majority of the human population of the Earth and this means that democracy would need to be constructed on a global scale. Our project examines several probable future trajectories of global political integration based on models of growth, decline and systemic transformation that are developed by studying patterns of political integration in several regions over the past 4000 years.

The main purpose of this project is to explain growth of cities and states since the emergence of complex chiefdoms. In the nineteenth and twentieth centuries expansion and intensification of intercontinental interactions has been called globalization. But earlier regional systems also exhibited similar waves of "globalization," albeit on a smaller spatial scale, and these waves of network expansion and contraction, punctuated by occasional huge jumps in the scale of networks, eventually led to the formation of the modern global social system. We have produced an inventory of "**upward sweeps**" in which the quantitative scale of the largest cities and empires in regions increased dramatically over previous entities in the same region. These are the cases of great expansion that must be explained in order to understand the long-term growth trend. Examples are the rise of the neo-Assyrian empire, and the Persian Achaemenid dynasty. These empires were quantitatively much larger in terms of territorial size that earlier polities had been. We are examining these cases in order to understand the long-term trend toward greater polity size and we are modeling the processes of state and city growth that have led to the contemporary situation.

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Project Title: Human and Social Dynamics in Myvatnssveit, Iceland, from the Settlement to the Present

Proposal Number: 0527732

HSD Emphasis Area: Agent of Change

Lead PI: Astrid E.J. Ogilvie, INSTAAR, University of Colorado
Co-PIs: Thomas H. McGovern, Hunter College, CUNY; Ian A. Simpson, University of Stirling, Scotland; Jon Haukur Ingimundarson, Stefansson Arctic Institute, Akureyri
Collaborators: Arni Einarsson, Institute of Biology, University of Iceland, and Myvatn Research Station; Orri Vesteinsson, University of Iceland and Icelandic Institute of Archaeology; Jennifer Brown, University of Stirling, Scotland

Research Goals:
1) To investigate the human and social dynamics of natural resource use and economic practice in Myvatnssveit, northern Iceland, in the context of environmental and climatic change over time, specifically the last ≅ 1100 years. 2) To use this information to evaluate decision-making and the management of change in order to develop sound long-term economic options and strategies for residents, educators, and other stakeholders. 3) A third, overarching goal is to facilitate the understanding of the complex consequences of how societies and cultures evolve and change over time from a global as well as an Arctic and sub-Arctic viewpoint.

Thematic Areas:
1) Reasons for the millennium-scale success or failure of farms and districts in surviving rapid and profound environmental change and climate fluctuation. 2) The relationship of major transformations in landscapes. 3) Placing modern shifts in land use in a broader environmental perspective while relating them to their local geographic, temporal and human and social contexts. 4) Connecting local knowledge of farmers and stakeholders to scientific data sets through the use of enhanced and accessible computer models used as interview tools and bridges to research partnerships. 5) Producing integrative modeling and syntheses of patterns of adaptive resilience to global and local changes with wide relevance beyond the circumpolar zone.

Recent Research Findings:
The 2008 field season accomplished all its goals, which included intensive archaeological investigations at the Skutustadir site in Myvatnssveit, as well as undertaking several interviews with local farmers regarding land use. It was found that the midden deposits at Skutustadir are a potentially major resource for just the long- term comparative synthesis which the project is undertaking. Human settlement began soon after the AD 871 +/-2 ash fall and there is thus clear evidence for occupation from first settlement in the late ninth century down to the late nineteenth century, with what appears to be an outstandingly complete suite of tephra. Conditions of preservation combined with the opportunity for a temporally controlled excavation of a laterally-distributed midden deposit appear to provide an extremely favorable opportunity for further large-scale excavation. Deposits contain rich organic material including pig, goat, cattle, sheep and bird bones, as well as marine and freshwater fish bones, and bird egg shell. There are clearly rich reserves for the eighteenth and nineteenth-century portions of the settlements in the area.

Challenges and Opportunities:
Association with the local school has provided an excellent opportunity for outreach. Continued research in this area will provide a rich collection of data relating to the role of a number of agents of change in the context of human and social dynamics.

Project Title: Integrated Analysis of Robustness in Dynamic Social Ecological Systems

Proposal Number: 0527744

HSD Emphasis Area: Agents of Change

Lead PI: John M. "Marty" Anderies, Arizona State University (ASU)
Co-PIs: Armando Rodriguez, ASU; Marco Janssen, ASU, Ann Kinzig, ASU; Charles Perrings, ASU.

International Partners: Eduardo Araral, Lee Kuan Yew School of Public Policy, National University of Singapore

Project Goals:

- Develop a publicly available, searchable database containing information regarding institutional and biophysical characteristics of more than 200 cases of social ecological systems including fisheries, community forests, and irrigation systems.
- Develop a body of theory and associated analytical tools based on dynamical systems and robust control techniques to study robustness-vulnerability trade-offs inherent for different institutional and biophysical configurations that appear in the database.
- Conduct a series of human subject experiments to characterize the effect of uncertainty and environmental variation on the capacity of groups of resource users to solve common-pool resource dilemmas.

Thematic Areas:

- Cultural, and societal adaptation to environmental change
- Robust control, management of rapid change, and decision-making in the face of changing risks and uncertainty.
- Social change as a process mediated by robustness-vulnerability trade-offs.

Methodologies:

- Qualitative analysis of case studies of social ecological systems based on the IAD framework
- Computer-based human subject experiments
- Development and analysis of dynamic models using techniques from robust control, dynamical systems, and bifurcation theory.

Recent Research Findings:

Based on the analysis of the classical renewable resource model and a newly developed model for small scale irrigation systems, the project team has established several fundamental sensitivity-performance trade-offs. In the case of a "robust" ecology – i.e. the simple perfectly compensatory growth model from the classical fisheries literature we have also established explicit relationships between parameter sensitivities – e.g. if a control law reduces sensitivity to price uncertainty by X%, sensitivity to uncertainty about the carrying capacity will increase by Y%. Our most recent analysis has focused on the relationships between critical depensation (potential irreversibility), delays, and discount rates. Although these interactions are quite complex, we have been able to establish some basic relationships. One such basic relationship suggests that as social discount rates increase, the cost to society of delays in decision-making decrease. Put simply, if you don't care about the future, a delay in a decision today that causes a population to go extinct far into the future is irrelevant. Similar general features are emerging from stylized models of irrigation systems. For example, a simple, small scale irrigation system in Nepal is extremely robust to variations in water supply volume in the main river, but extremely sensitive to shifts in the seasonality of the river flows. Developing a better understanding of the details associated with such general features of social-ecological systems constitutes the main thrust of the project's ongoing research effort.

Challenges and Opportunities:
Translating the details of institutional arrangements into factors that affect the dynamics of social-ecological systems has proven to be exceedingly difficult. The project is attempting to add richness to basic theoretical models by looking at multiple case studies of real-world systems. Although extremely challenging, this process offers the opportunity of seeing the empirical cases studies in a new light.

Project Title: Dynamics of Human Behavior: Modeling the Dynamics of Dyadic Interactions

Proposal Number: 0527766

HSD Emphasis Area: Dynamics of Human Behavior

Lead PI: Emilio Ferrer, University of California, Davis
Co-PIs: Diane Felmlee, Fushing Hsieh, Keith Widaman

Project Goals:

- To develop and compare statistical and mathematical models to analyze dynamic, dyadic systems
- To identify dynamic patterns of affective processes in dyadic interactions
- To examine whether dynamic patterns of affective processes are predictive of relationship quality and instability over time

Thematic Areas:

- Statistical Methodology
- Dyadic Interactions
- Emotion

Methodologies:

- Data collection methodology involves daily self-report data, questionnaires, and physiological measures (i.e., blood pressure, heart rate variability, impedance, respiration, galvanic skin response)
- Data analysis methodology involves time series analysis, dynamic factor analysis, differential equation modeling, exploratory non-parametric approaches, small-world network modeling, and survival analysis

Recent Research Findings:

Methodological Findings

Simulation Work on State-Space Modeling

A large number of analyses were aimed at developing methods for examining dyadic interactions. We have investigated the use of state-space modeling (SSM) techniques for fitting dynamic factor analysis models directly to raw data. We have used the Kalman smoother via the Expectation-Maximization algorithm to obtain maximum likelihood parameter estimates. In particular, using Monte Carlo studies we have investigated the finite sample properties of the estimates in SSM when common factors are involved. Results from these analyses indicate that the factor loading estimates (i.e., relationship of the factors to the observed variables), transition matrix (i.e., auto-regression and cross-regression coefficients representing dynamics), and unique variances (i.e., variance specific to the observed variables) are asymptotically normal, accurate, precise, and robust, especially for moderate and long time series (i.e., 100 and 500 measurement occasions, respectively). The estimates of state residual variances (i.e., unpredicted part of the latent factors) show a positive bias for shorter time series (i.e., 50 measurement occasions) but become accurate and precise with long series.

Dynamic Factor Analysis

We have also examined the dynamic factor analyses for investigating dyadic interactions with multiple dyads. We have used simple ordinal least squares as the estimation method. Our findings about the use of such methods are promising and indicate that the same model can be fitted to each dyad and then use the estimates from each analysis to build empirical distributions of the parameters.

In all analyses using dynamic factor models, the results indicate evidence for a solid factorial

structure in the data over time. That is, there is a good discrimination between positive and negative affect and between the two individuals in the dyad. This is true when examined through aggregate analyses (i.e., all individuals) and the individual analyses (i.e., each dyad separately). With regard to the time series part of the model, most of the dynamics in the factors (i.e., relationships between positive and negative affect over time) are mostly predicted by external random shocks to the system (i.e., part that is random and not included in the model).

When a dynamic model is fitted to each dyad separately, the results suggest large variability across dyads. That is, although on average there is not much prediction in the dynamics between positive and negative factors over time (within and across the two people in the dyad), for some dyads there are strong systematic dynamics. These dynamics apply mostly to influences that each factor exerts on itself the next day. There are not many perceptible influences from one factor to another over time.

It appears that the daily fluctuation in emotions is different for each person and each couple. Based on this premise, modeling dynamics for all dyads – or, in general, all individuals – might not be a reasonable approach. This approach would a priori assume that all dyads have a similar pattern of variability and dynamics and, moreover, would not adequately represent the dynamics for any particular dyad. Rather, it seems more reasonable to start from the individual information and build up to generate results that apply to the sample, but based on each person's information.

Exploratory Methods
We have also studied the use of exploratory non-parametric approaches based on computational modeling applied to each couple. These methods provide with intuitive information about the dynamics for each person and dyad and serve as an initial step for building a model of dyadic interactions.

One of these exploratory methods is based on patterns of variability. We created an algorithm for examining affective dynamics based on such patterns of variability. The algorithm identifies periods of stability based on length of time and amplitude of emotional fluctuations. The patterns of variability and stability are quantified at the individual and dyad level, and the approach is illustrated using data on the daily emotional experiences from individuals in romantic couples. The approach examines the fluctuations of the emotional experiences for each person and inspects the overlap fluctuations between both individuals in the dyad. The individual and dyadic indices of variability are then use to predict the status of the dyads (i.e., together, break-up) one year later.

Findings about Dyadic Interactions
One of our goals in this project is to represent intra-individual and dyadic processes. We have investigated the variability in affective experience of individuals in dyads, examining fluctuations over time in affect for each dyad, as well as examining differences in such relationships across dyads. For this, we have examined a number of exploratory and confirmatory models to data from all dyads and separately to each dyad separately. Our main objective here was to generate sample results based on information from each dyad.

Findings from these analyses indicate that daily fluctuations in emotional experiences show a clear, strong and consistent structure with a robust discrimination between positive and negative affect (general and specific-domain) and between the two individuals in the dyad. This appears to be true for analyses with the pooled sample and for analyses with each dyad separately.

With regard to the influences in the affect, our results suggest that most of the dynamics in the factors (i.e., positive and negative affect) are not predicted by the trait-like autoregressive part of the model that represents stability of affective experiences from one day to the next, but rather are the result of random shocks to the system that varied from day to day. Moreover, the dynamics appear to be moderate in magnitude and due almost solely to autoregressive

influences of each factor at one time to the same factor at the next time, with a virtual absence of cross-lagged influences among factors within or between the individuals comprising a dyad. Based on these estimates, one would conclude that positive affect and negative affect have little in the way of mutual influences and that males and females within dyads have affective experiences that have little interconnection.

When the model is fitted to each dyad separately, however, the results reveal substantial variability in such dynamics across dyads. That is, although some dyads reveal little prediction in dynamics over time, other dyads exhibit very strong and systematic dynamics. When looking at the differences across dyads, important patterns are apparent. For certain dyads, lagged influences between factors over time are very large, suggesting that positive and negative affect have clear effects on each other, both within persons and, importantly, between persons comprising a dyad. These results confirm everyday phenomenology, in which our affective states seem to influence one another and we engage in interactions with those close to us that produce affective reactions in both partners to the interaction.

Overall, these results suggest that modeling dynamics for all dyads – or, in general, all individuals – appears to be an unreasonable approach, one that is likely to mask inter-individual differences across dyads in affective dynamics. The aggregate approach assumes a priori that all dyads have a similar pattern of variability and dynamics and, moreover, cannot adequately represent the dynamics for any particular dyad if the dyad departs from the norm or average. Because of this failure, it seems more reasonable to us to start from the information from each individual dyad and build up to generate results that apply to the sample and, hence, to the population, with results based on the uniqueness of each person's and each dyad's information.

Project Title: IT-Enhanced Market Design and Experiments

Proposal Number: 0527770

HSD Emphasis Area: Agents of Change

Lead PI: Dan Friedman, University of California, Santa Cruz
Co-PIs: James C. Cox, Georgia State University; James Spohrer, IBM Almaden Research Center; and Daniel Zeng, University of Arizona.
Collaborators: Nirvikar Singh and Ryan Oprea, UCSC; Vjollca Sadiraj, GSU; Christorpher Campbell, IBM Almaden; Steven Gjerstad, Purdue University; and Wenjie Zhan, Huazhong University of Science and Technology, Wuhan, China.

Research Goal:
To identify the market formats and agent behaviors that are most effective in realistic IT environments. We consider both one-sided markets (auctions) and two-sided, and study humans and automated agents who participate in markets asynchronously.

Thematic Areas:
The research falls mainly in the Agents of Change (AOC) area of emphasis but also has implications for the Dynamics of Human Behavior (DHB) and the Decision Making, Risk and Uncertainty (DRU) areas. Properly incorporating the new information technology into the economy, transforming markets and services, is a key to economic growth and greater social equity. The transformation itself is largely in the hands of business people and policy makers, and their work will be greatly aided by science. The IT science is solid but the economic science lags. Our fundamental research will help close the gap. Markets once were mainly local, but now increasingly coordinate and control human activities on a national and global scale, echoing themes of the DHB area of emphasis. And innovations in market strategies certainly reflect the main DRU themes at both the individual and group level.

Methodologies:
We develop new theoretical models for IT-enabled markets, and test and refine them (and previous models) in computer simulations and in laboratory experiments with human subjects and automated agents.

Recent Research Findings:
An Experiment on the Core, by Huibin Yan and Daniel Friedman, submitted to an economics journal, August 2008. Each of $n\geq 1$ identical buyers (and $m\geq 1$ identical sellers) wants to buy (sell) a single unit of an indivisible good. The core predicts a unique and extreme outcome: the entire surplus is split evenly among the buyers when $m>n$ and among the sellers when $m<n$; the long side gets nothing. We apparently perform the first test of this core conjecture in the lab, using $n+m=3$ or 5 randomly rematched traders and minimal imbalances ($m=n\pm1$) in three market institutions. In the standard continuous double auction, the surplus indeed goes overwhelmingly towards the short side. The DA-Chat institution allows traders to have cheap talk prior to the double auction, while the DA-Barg institution allows the long siders to negotiate enforceable profit sharing agreements while trading. Despite frequent attempts to collude and occasional large deviations from the core prediction, we find that successful collusion is infrequent in both new institutions. A disproportionate fraction of the successful collusions are accompanied by appeals to fairness.

Preemption Games: Theory and Experiment, by Steven T. Anderson, Dan Friedman, and Ryan Oprea. Submitted to an economics journal, July 2008. Several investors face an irreversible investment opportunity whose value V is governed by Brownian motion with upward drift and random expiration. The first investor i to seize the opportunity before expiration receives the current V less a privately known cost C_i, and the other investors receive nothing. We characterize the Bayesian Nash Equilibrium (BNE) for this game, extending previously known

results. We also report a laboratory experiment with 72 subjects randomly matched into 600 triopolies. As predicted in BNE, subjects in triopolies invested at lower values than in monopolies; changes in Brownian parameters significantly altered investment values in monopoly but not in triopoly; and the lowest cost investor in a triopoly usually preempted the others. Evidence was mixed on the prediction that higher cost brings smaller markups. Overall, subjects' earnings came rather close to the BNE prediction.

"Seller Strategies on eBay: Size Matters", with Steven Anderson, Garrett Milam and Nirvikar Singh, forthcoming, *International Journal of Electronic Business*. We examine seller tactics in 1177 eBay auctions. The largest volume sellers make rather homogeneous choices; smaller sellers are more heterogeneous. Some tactics, such as starting the auction with a â€˜Buy it Nowâ€™ offer, appear to increase revenue. Perhaps due to intense competition, however, the overall impact of most tactics appears to be quite small. The main exception is the use of a secret reserve price, which raises the winning bid conditional on a sale, but reduces the probability of a sale. This can be advantageous, depending on the sellerâ€™s risk aversion and impatience.

"Buy it Now: A Hybrid Internet Market Institution", with Steven Anderson, Garrett Milam and Nirvikar Singh, *Journal of Electronic Commerce Research* 9:2, 137-153 (May, 2008). This paper analyzes seller choices and outcomes in approximately 700 Internet auctions of a relatively homogeneous good. The 'Buy it Nowâ€˜ option allows the seller to convert the auction into a posted price market. We use a structural model to control for the conduct of the auction as well as product and seller characteristics. In explaining seller choices, we find that the 'Buy it Nowâ€˜ option was used more often by sellers with higher ratings and offering fewer units; and posted prices were more prevalent for used items. In explaining auction outcomes, we find that auctions with a 'Buy it Nowâ€˜ price had higher winning bids, ceteris paribus, whether or not the auction ended with the 'Buy it Nowâ€˜ offer being accepted, possibly reflecting signaling or bounded rationality. We also find that posting prices, by combining 'Buy it Nowâ€˜ and an equal starting price, was an effective strategy for sellers in the sample.

In their research project on “Service Markets and Dynamics”, Jim Spohrer, Christopher Campbell, and Ankur Chandra have constructed several NetLogo models of service markets to examine current behaviors and growth patterns observed in the knowledge-based services business (e.g., technical services, outsourcing, consulting). Most service markets today are *contract & sealed bid auctions* with one or more bidders. In this case, both the bid price and the contract specifications are considered in determining the winning bid. Unlike the institutional markets used for trading products, securities, or commodities, this format is used due to the inherent complexity and customization required of many services---i.e., lack of a standardized contract. Given this complexity in the service business, we observed several phenomena including:

- Complexity makes it difficult for buyers to estimate the marginal benefit for their specific company.
- The benefits produced by a new, unproven service are uncertain adding a risk premium into the demand curve.
- Uncertainty in service delivery results in a “hold-up problem” for customers causing many of them to avoid market participation altogether.
- Marginal benefit maximization in the short-term is the goal of most service providers rather than improved service quality or service process reinvestment.

Some of these observations have been modeled so far and reproduce the slow-growth, boom-bust cycles, and relatively low margins plaguing the services business. Implementation of models with varieties of market institutions, contract forms and processes, and electronic enhancements is being performed in hopes of mitigating these problems.

In a research project on “Agent Competition and Evolutionary Market Stability”, MarketLink has been upgraded to include agents with various intelligence levels to compete with each other and human participants. The new agents include: Zero-intelligence (ZI), Zero Intelligence Plus (ZIP), Belief-base Learning (BL), and Background Trader (BT). These agents are being beta-tested for

all four 2-sided market formats that have been implemented in Marketlink, i.e., posted-offer, bilateral negotiation, call-market, continuous double auction.

"Succeeding through service innovation: A service perspective for education, research, business and government" was published as a white paper (http://www.ifm.eng.cam.ac.uk/ssme/) by the University of Cambridge. The paper was based on outputs from the Cambridge Service Science, Management and Engineering Symposium, held 14-15 July 2007 Møller Centre, Churchill College, Cambridge and calls for a doubling of the funding for service education and research to ensure future economic prosperity and global competitiveness. More than 100 of the world's leading academics and business leaders contributed to the report. The report also highlights the fact that service systems such as transport, communications and healthcare now form the major part of the modern economy, but suffer from a lack of research support compared to technology research. This imbalance needs to be rectified, it argues. "The growth of services economies, coupled with the evolution of businesses from multinational businesses to globally integrated enterprises, calls for a new approach in order for individuals, industries and countries to remain innovative and competitive," said Dr. James C. Spohrer, Director of Service Research at IBM. Many strands of relevant service science expertise exist but they tend to reside in "disconnected silos" of academic disciplines. In response, the report calls for a "systematic and interdisciplinary approach to services innovation". The white paper makes the following recommendations:

- **Universities** should offer courses in the emerging field of Service Science, Management and Engineering (SSME) – teaching graduates to become "adaptive innovators", capable of working entrepreneurially across traditional boundaries.
- **Researchers** should embrace an interdisciplinary approach to address business and societal 'grand challenges'.
- **Governments** should fund SSME education and research and collaborate with industry and academia to develop service innovation roadmaps.
- **Businesses** should establish employment policies and career paths that encourage 'adaptive innovators' and provide funding and support for service research and education.

- Wenjie Zhan and Daniel Friedman , "Markups in Double Auction Markets". *Journal of Economic Dynamics and Control* 31:9, 2984-3005 (September 2007).
- Ryan Oprea, Daniel Friedman and Steven T. Anderson, "A Laboratory Investigation of Deferral Options," by, UCSC Working Paper #635, March 2007
- James C. Cox, Vjollca Sadiraj, Bodo Vogt, and Utteeyo, "Is There a Plausible Theory for Risky Decisions?" (Experimental Economics Center Working Paper 2007-05, Georgia State University).
- James C. Cox and Vjollca Sadiraj, "Risky Decisions in the Large and in the Small: Theory and Experiment" (forthcoming in J.C. Cox and G.W. Harrison (eds.), *Research in Experimental Economics, Vol. 12: Risk Aversion in Experiments,*JAI Press).
- James C. Cox, Daniel Friedman, and Vjollca Sadiraj, "Revealed Altruism" (forthcoming in *Econometrica*).
- James C. Cox, Elinor Ostrom, and James M. Walker, "Trust in Private and Common Property Experiments" (presented at the panel on "Fairness Economics and Political Economy" at the 103rd American Political Science Association Annual Meetings, Chicago, Illinois, August 30-September 2, 2007).
- Jim Spohrer, Laura Anderson, Norman Pass, Tryg Ager, and Daniel Gruhl, "Service Science" *Journal of Grid Computing* 6, 313-324, 2008

Challenges and Opportunities:

So far we have focused mainly on existing formats for one and two sided markets. We hope to begin running parallel markets in more than one format, to consider new hybrid formats, and to construct a greater variety of automated agents. It is always a challenge to coordinate the efforts of three very different labs, but it also creates unique opportunities.

Project Title: Understanding Agents of Scientific Change: the Case of Embryo Research

Proposal Number: 0623176

HSD Emphasis Area: Agents of Change

Lead PI: Jane Maienschein, Arizona State University
Co-PIs: Manfred Laubicher; Gary Marchant; Daniel Sarewitz
Collaborators: (US) Joel Gereboff, Jason Robert, Michael Dietrich, Scott Gilbert, Henry Greely, Stuart Newman, Jeffrey Schwartz,
International Partners: (Australia) Rachel Ankeny, (Austria) Gerd Müller, (Canada) Brian Hall, Francoise Baylis, (Germany) Christina Brandt. Hans-Jörg Rheinberger, Urs Schöpflin, (UK) Nick Hopwood

Project Goals:
- Identify, collect, document and analyze episodes of importance in embryo research, seeking to understand the complexities of scientific change in social context.
- Develop a collaboratory environment in which an interdisciplinary and international network of scholars -- who normally work on disparate questions with apparently incompatible tools -- pursue research with transformative questions in new ways.
- Train faculty members, postdocs, graduate students, and undergraduate researchers in research tools as well as in database development.
- Create such an environment by developing a dynamic, interactive relational database that makes joint intellectual projects, scholarly documents, research tools, and knowledge products available to multiple user groups and set up a series of workshops to explore these questions and create tangible outcomes in form of novel scholarly products.

Methodologies:
- Analytic methodologies from History and Philosophy of Science and related disciplines such as legal and religious studies.
- Interdisciplinary collaborations are enabled by a collaborative digital research environment through an open-source object-oriented relational digital repository system (Fedora).
- Development of a scholarly journal for original peer-reviewed and edited articles, in the Embryo Project Encyclopedia, which has been registered with the National Library of Medicine and for which articles are included in PubMed and MedLine.
- Collaborations start with research workshops that bring researchers into the process, continue with developing targeted research projects within the digital environment.

Recent Research Findings:
- Defined Research Projects ask questions and draw on methods across disciplines, with a focus on the agents that have contributed to changing embryo research over time. These involve bringing together articles on people, places, practices, concepts, contexts (social, policy, legal, religious, and scientific), images, and literature.
- The accumulating knowledge base (the Embryo Project Encyclopedia) forms the basis for further research projects. See embryo.asu.edu.
- Workshops have also revealed the importance of working with other scholars on digital infrastructure, to share best practices and to collaborate in developing Fedora-based relational databases accessible to all. We are developing ways to share our findings broadly.
- As a direct consequence of our interdisciplinary approach and working in a digital environment we have been able to develop new approaches that draw on multiple sources of different kinds that are available in places not commonly used by scholars focusing on a question within a single methodology or paradigm. This approach has also identified several new research challenges for working within the future Web 2.0 environment (see Challenges and Opportunities).

Thematic Areas:

- Agents of change in the history of embryo research will only emerge as we accumulate more entries in the Encylopedia database and can discover creative linkages because of the relational database approach.
- One theme relates to the importance of sharing infrastructural knowledge, so that scholars in different related projects do not have to keep re-inventing the same methods of work.

Challenges and Opportunities: With our expertise in databasing, content production, and workflow management acquired over the past 1 ½ years, we have the opportunity to become the world's foremost electronic source for comprehensive information and new research about embryology in context. Major challenges lie in (1) establishing and increasing active international collaborations and (2) working with our partners at the ASU library, the Max Planck Institute for the History of Science in Berlin, and the Marine Biological Laboratory in Woods Hole, Massachusetts, to find new ways to store and retrieve content, render our content accession process more efficient so that it facilitates transformative research, and make electronic searches productive to users. The Embryo Project Encyclopedia and database that stores our research findings and is the foundation of our scholarly projects will be further developed as an exemplary application within the Fedora based eSciDoc project (http://www.escidoc-project.de/JSPWiki/en/Startpage). This way our research methodologies and tools can be used in the context of related interdisciplinary web-based research projects. And we achieve even broader impacts than through our database and its offerings alone.

Jane Maienschein
Regents' Professor, President's Professor, and Parents Association Professor
School of Life Sciences 874501
Arizona State University
Tempe AZ 85287-4501

Project Title: DHB: An Interdisciplinary Study of the Dynamics of Second-Language Fluence

Proposal Number: 0623805

HSD Emphasis Area: Dynamics of Human Behavior

Lead PI: Richard Sproat, University of Illinois at Urbana-Champaign
Co-PIs: Kay Bock, Mark Hasegawa-Johnson, Brian Ross, Chilin Shih
Collaborators: Fred Davidson

Research Goals:

1. Establish criteria and valid tests for second-language fluency
2. Correlate second language fluency with first language fluency in controlled psycholinguistic tests
3. Develop automated methods for assessing second-language fluency

Methodologies:
The basic data for this project come from student performances in Third Year Mandarin classes at the University of Illinois. Students are asked to perform either monologue presentations, or engage in debates with other students. The performances are videotaped. Mandarin classes at UIUC have students who had no prior exposure to Mandarin, as well as "heritage learners", who are often almost native speakers. Therefore there is a wide range of fluency observed among the students, even at the Third Year level.

The student performances are rated by trained raters using a rating methodology developed by Fred Davidson's foreign language assessment group (FLAG) at UIUC for this project.

In addition to measures of second language fluency, students are also asked to participate in psycholinguistic experiments to test their first and second language fluency in a controlled laboratory setting. The tasks involve time telling and description of pictures, following previous work of co-PI Bock.

The audio of the performances is being analyzed for acoustic and linguistic features that can be used to automatically detect fluency levels that will correlate with the trained ratings of the speakers.

Recent Research Findings:

Data collection:
We have to date a large amount of recorded data, which we believe to be the largest database of spontaneous second-language performance by language learners in existence. The data has been annotated to various levels. To date we have:

- 129 hours of video-audio recording
- 28 hours of text transcription
- 36 hours of speaker turn annotation
- 700 disfluency labels
- 5200 phone labels

Detection of filled pauses:
Use of filled pauses – *um, uh* or their Chinese equivalents – correlate with fluency. More fluent speakers tend to use fewer such disfluencies. We have investigated a number of features that might help contrast between filled pauses and other speech events. These include duration, spectral stability and tonal variation.

We continue to work on disfluency detection: this year we plan to investigate if autocorrelation at the signal level will help us detect repetitions, which are common in our data.

Rating Scales
The major tasks accomplished by Foreign Language Assessment Group (FLAG) in 2008 include further revision of the rating scales for assessing Chinese fluency and launching the rating study in which 120 speech samples produced by L2 learners of Mandarin were evaluated by native speakers of Mandarin. A follow-up study that explores raters' on-line rating experience and their perceptions on L2 fluency according to samples they rated is currently underway.

1. Construction of Rating Scales based on Empirical Research
A major source that contributed to the further revision of the rating scales was the findings of a qualitative study, conducted in spring 2008, where the nature of fluency in 2nd language Mandarin construct was further investigated and defined. The most recent rating scales reflected the following changes: use of laypeople's term labeling the descriptors, increasing the number of rating criteria (seven in total), and creating a simplified scale of four proficiency levels to aid in untrained raters' comprehension of the rating instrument.

2. Rating Study: Perceptions on L2 Fluency
Forty native speakers of Mandarin, from different Mandarin-speaking regions (China, Malaysia, Singapore, and Taiwan), were recruited to evaluate the 120 speech samples produced by L2 learners of Mandarin. Two familiarization sessions were given in spring 2008 for the purpose of getting them acquainted with the rating procedures. Rating results were collected during summer 2008.

The speech samples were given to raters in the forms of video and non-video (sound only) files for the researchers to determine whether or not a visual effect influence their conceptualization of L2 fluency.

3. Follow-up Study
A survey study which is currently being undertaken is to further evaluate the appropriateness of on-line rating instrument as well as to further define factors influencing raters' judgment on L2 Mandarin fluency construct.

4. Paper presentation at Conferences on Language Testing
The work accomplished so far by FLAG has been presented in the form of posters at Language Testing Research Colloquium (LTRC), held at China in June 2008.

Psycholinguistic Experiments on Fluency:
One component of the NSF-HSD project addresses the psycholinguistic correlates of fluency in second-language learners of Mandarin. The research in this part of the project involves the monitoring of eye movements and tracing their timing during fluent speech. The purpose is to evaluate changes in the efficiency of transforming perceptual/conceptual content, in the form of visual scenes and events, into language. Over the past year, there has been significant progress in readying the experimental protocols and beginning data collection. The developments fall into three categories.

First, speech samples from native Mandarin speakers were collected for the development of an automatic Mandarin speech-recognizer by Hasegawa-Johnson and Sproat. Currently, two other speech recognition systems are being evaluated on samples of speech from native Mandarin speakers, for use in measuring the temporal linking between speech and the eye movements directed to scene elements.

Second, for testing learners, we have gathered baseline data on the fluency of Mandarin and English speech under the same conditions and with the same materials. The baseline experiment for Mandarin used native Mandarin speakers and is being analyzed. The English baseline is in

progress, using the learners themselves. During these sessions, speakers describe simple line drawings while their speech is recorded and their eye-movements are monitored. So far, we have tested nine native Mandarin speakers and twenty-five learners. All English data has been transcribed and analyzed with results demonstrating the linking between eye movements and utterance production expected from previous research (Bock, J. K., Irwin, D. E., Davidson, D. J., & Levelt, W. J. M. (2003). Minding the clock. *Journal of Memory and Language, 48*, 653-685). We have hired an undergraduate research assistant, a native Mandarin speaker, who has transcribed more than half of all the Mandarin data.

Finally, an auditory test of phonological working memory is being administered to all participants following the eyetracking session. Individual differences in phonological working memory are a known predictor of second-language-learning success. We plan to evaluate whether the same individual differences also help to predict variations in fluency.

Challenges and Opportunities:
We expect the major challenges to continue to be the creation of robust automated methods for second language fluency assessment. The main technical difficulties at present have to do with the recording conditions in the classroom, which have a strong negative effect on the robustness of speech algorithms. Unfortunately this is not something that can easily be controlled for, and in any case the eventual goal will be to have deployable systems that work with data from real classroom situations and it would be unrealistic to expect “clean” conditions in such situations.

There is however substantial opportunity for this project if it is successful. There is a huge increase in interest in second-language learning in the US, partly fueled by recent political events, partly by economic considerations and partly by the growing awareness that multilinguality is an asset in a global society. A major bottleneck in second language learning is the availability of both teachers of many languages, as well as methods to assess student progress. If it is possible to automate at least some of the process, that has a huge potential.

Project Title: Shared Governance of Risk

Proposal Number: 0623900

HSD Emphasis Area: Decision Making, Risk, and Uncertainty

Lead PI: Peter J. May, University of Washington
Co-PIs: Bryan D. Jones, University of Texas
Collaborators: WilliamWallace, Rensselaer Polytechnic Institute

Project Goals:
Enhance understanding of:

1. The coherence of federal homeland security and risk management policies.
2. The factors that shape organizational capabilities to respond to multiple risks.
3. The dynamics of organizational response for risk management.

Thematic Areas:

1. Policy processes: agenda setting and policy disruption.
2. Bureaucratic decision-making: responses to disruption in policy signals.
3. Systems modeling: modeling of organizational response to disruptions.

Methodologies:
Our primary research emphasis concerns changes in the federal policy agenda from 1988 through 2004 within eight policy areas that comprise major components of what is currently labeled as homeland security: border protection, domestic preparedness, food safety, information security, natural disaster preparedness, public health emergencies, technological accidents, and transportation safety. For each policy area we are collecting data from congressional hearings, public testimony, and public laws about changing issue emphasis, policy justifications, and relevant players. We have coded the topical foci of 1,651 hearings. In year two, we have turned to data collection and analysis of testimony of federal agency officials (2,038 witnesses) and consideration of the involvement of different interests (7,497 witnesses) for the period 1995 through 2004. A second research activity in year two has been continued analysis of data collected during year one concerning the agenda of federal disaster agencies (principally FEMA and DHS) from 1984 through mid 2006. This entailed collection and coding of 1,421 rules issued by these agencies and another 56 guidance documents. These data are the basis for analyzing how key federal bureaucracies responded over time to the policy disruptions associated with terrorism.

Recent Research Findings:
One set of findings, which extend earlier SGER-funded research, concerns how public bureaucracies respond to policy disruptions. We draw on a variety of scholarship about public bureaucracies to develop a theory about the bureaucratic organization of attention and its consequences. We suggest that agencies have a broad choice between a delegated response (the normal response) and a centralized response (an exceptional response) for which the choice has a variety of consequences for organizational performance. In illustrating these notions, we trace federal agency attention to the threat of terrorism as it gained prominence on the national policy agenda over the 1980s to 1990s and became a prominent issue after the terrorist attacks of 2001. The consequences of the Department of Homeland Security's centralized attention to the terrorism threat suggest a paradox of issue attention. Though concentration of authority at the top of the organization holds the prospect of control over the substance and speed of policymaking, this control is highly circumscribed by the limits of attention faced by all organizations.

A second set of findings from our research to date concerns theoretical and empirical aspects of policy disruptions that affect multiple areas of policymaking—what we label widespread policy disruptions. Our theorizing leads us to consider the effects of widespread disruptions in gaining the attention of elected officials and in affecting policymaking. Disruptions of this scale are

relatively rare for which the threat of terrorism offers a preeminent example. The potential for widespread policy disruptions raises fundamental questions: How do these disruptions play out within and across policy subsystems? How do these reverberate among federal agencies? How disruptive are these for policymaking and for governing?

By 2001 the terrorism issue had clearly infiltrated the policy agendas of the eight policy subsystems we study. It would be hard to imagine otherwise. But, we show that the level of policymaking activity differs among subsystems. Activity in some subsystems atrophied (food safety, technological accidents, natural disasters) while policymaking volatility increased in others (border protection, transportation safety, public health emergencies, information security, domestic preparedness). We attribute these differences to two factors. One is the greater susceptibility of the heated-up subsystems to the intrusion of the terrorism issue. A second consideration for shaping policy engagement is the broader limits of the organizational attention within Congress.

The disjunction between the patterns in attention and policymaking activity that we observe shows the powerful influence of existing institutions and interests in buffering against widespread policy disruptions. The threat of terrorism and especially the events of 9/11 fostered a crisis that could have involved paradigmatic policy change leading to substantial alteration of federal agency involvement across subsystems. Yet, we show more muted impacts in reshaping the influence of federal agencies within the subsystems we study than might have been expected from the massive reorganization that created the DHS. These findings underscore the limits of reorganizations and the difficulty of altering institutional relationships within subsystems.

Results to date have appeared as follows:

Peter J. May, Samuel Workman, and Bryan D. Jones, “Organizing Attention: Responses of the Bureaucracy to Agenda Disruption,” *Journal of Public Administration Research and Theory* 18(4): 517-541.

Peter J. May, Joshua Sapotichne, and Samuel Workman, “Widespread Policy Disruption: Terrorism, Public Risks, and Homeland Security,” *Policy Studies Journal*, in press.

Peter J. May and Samuel Workman. 2008. “The Paradox of Agency Issue Attention: The Bush Administration and Homeland Security,” in Colin Provost and Paul Teske eds. *Extraordinary Powers, Extraordinary Times, Extraordinary Powers? President George W. Bush’s Influence over Bureaucracy and Policy*. London: Palgrave Macmillan Publishers. In press.

Rachel A. Dowty, Peter J. May, Colin E. Beech, and William A. Wallace, “Organizational Culture and the Katrina Response in Louisiana,” in Rachel A. Dowty and Barbara L. Allen eds. *Decision Making in Times of Disaster.* Baton Rouge, LSU Press. In press.

Peter J. May, Bryan D. Jones, and Samuel Workman. 2008. “Policy Disruptions and Preparedness Agendas: Issue Attention and Limits to Learning.” Prepared for the “Learning from Crises and Major Accidents” Conference Stockholm, May 12-13, 2008; Seattle: Center for American Politics and Public Policy.

Peter J. May, Joshua Sapotichne, and Samuel Workman. 2007. “Policy Disruption across Subsystems: Terrorism, Public Risks, and Homeland Security.” Prepared for the Annual Meeting of the American Political Science Association, Chicago, August 29 – September 2, 2007; revised version presented at the Association for Public Policy Analysis and Management, Washington DC, November 8-10, 2007.

Peter J. May, Joshua Sapotichne, and Samuel Workman. 2008. “Policy Disruption and Interest Mobilization: The Terrorism Bugaboo.” Prepared for the Annual Meeting of the American Political Science Association, Boston, August 28 – September 1, 2008.

Peter J. May, Samuel Workman, and Bryan D. Jones. 2008. “Organizing Attention: Responses of the Bureaucracy to Agenda Disruption” Paper prepared for the Annual Meeting of the Midwest Political Science Association, Chicago, April 3-6, 2008.

Challenges and Opportunities:
There have been the usual challenges of project coordination and keeping on top of changing dynamics of policy areas—homeland security and terrorism—that are in constant flux. The emphases that have evolved for this project provide promising opportunities for this research to make notable scholarly contributions to the study of bureaucracy and policy processes. Prior research on agendas of public bureaucracies has focused on budgetary outputs and enforcement actions. We provide a different perspective in studying the substance of agency agendas. Prior research on policy agendas has emphasized disruptions within single subsystems. We provide a different perspective in studying policy disruption across a number of policy subsystems.

Project Title: Collaborative Research (DRU): Shared Governance of Risk

Proposal Number: 0623907

HSD Emphasis Area: Decision Making, Risk, and Uncertainty

Lead PI: William A. Wallace, Rensselaer Polytechnic Institute
Collaborator: Peter J. May, Center for American Politics and Public Policy (CAPP), University of Washington

Project Goals:

- Develop approaches to organizational theory that open new frontiers to how organizational cultures function and how they can be assessed empirically to assist in organizational coordination, planning, and assessment
- Develop techniques for applying these approaches to organizational cultures faced with crisis situations
- Contribute to our understanding of organizational culture and risk

Thematic Areas:

- Organizational Science
- Disaster response
- Agent-based modeling of social processes
- Risk management

Methodologies:

- Qualitative data analysis including text
- Simulation

Recent Research Findings:
This project has developed an Organizational Response Culture In Disasters Simulation (ORCIDS) programmed in Visual Basic .NET. This simulation is undergoing ongoing development to allow researchers, educators, and organizational representatives to simulate organizational effectiveness in resolving disaster tasks by assessing the way the organizational culture approaches crisis task resolution.

Construction of an information database composed of government documents, periodicals, and other background material collected since August 28, 2005 regarding government responses to Hurricane Katrina is ongoing.

Challenges and Opportunities:
Creating an archive of materials pertinent to the response to Hurricane Katrina that will be useful for additional scholarly work is a definite challenge. In addition there is an opportunity to continue the modeling effort and utilize agent-based modeling tools that are becoming available.

Project Title: An Integrative Impact Evaluation of China's Ecological Restoration Programs

Proposal Number: 0624018

HSD Emphasis Area: Agents of Change

Lead PI: Runsheng Yin, Michigan State University Dept. of Forestry
Co-PIs: David Rothstein, Michigan State University Dept. of Forestry; Jiaguo Qi, Michigan State University Dept. of Geography
Collaborators: Xiangzheng Deng, Center for Chinese Agricultural Policy, Chinese Academy of Sciences (CAS); Jintao Xu, Peking University College of Environmental Science; Can Liu, Forest Economics and Development Research Center, State Forest Administration; Yukuan Wang, Institute of Mountain Hazards and the Environment, CAS; Shunbo Yao, Northwest Agricultural and Forestry University

Research Goals

1. To evaluate the environmental and socioeconomic impacts of China's ecological restoration initiatives, including the Natural Forest Protection Program and the Sloping Land Conversion Program;
2. To gain a clear understanding of and thus an enhanced ability to execute these unprecedented programs of ecological restoration;
3. To generate insights for fostering adaptation options and sustainability strategies within and outside of China.

Thematic Areas:

1. Environmental dynamics – erosion/desertification control, biodiversity protection, and carbon storage;
2. Socioeconomic impacts – livelihood change, targeting efficiency, and cost effectiveness;
3. Student engagement in primary research and experiential learning.

Methodologies:

1. Building comprehensive geospatial and statistical datasets at multiple scales;
2. Developing effective treatment effect and ecosystem service models to estimate the socioeconomic and ecological effects induced by implementing the programs;
3. Integrating expertise and approaches in landscape ecology, social science, remote sensing, and climate change.

Recent Research Findings:

1. The restoration programs have been implemented differently. In some areas they have been very successful, while in other areas they have failed; the success or failure, as reflected in the land use and land cover and the socioeconomic and environmental impacts, has much to do with the effectiveness of the local schemes of program execution and follow-up monitoring and management.
2. Biodiversity (measured in terms of multiplicity and variation of species and the structure of regional ecosystems) and erosion status have seen improvement in certain places.
3. Similarly, carbon stored in the vegetation of regional ecosystems has trended up, but that stored in the soil may not have increased if erosion has not been mitigated significantly.
4. Livelihoods of households and communities, as reflected in income, employment, and food production, have been mostly affected in positive ways. But the in-discriminatory, top-down approach to program implementation is inefficient, and the transition to a more sustainable economy has been slow to come by.

Challenges and Opportunities:

1. China's ecological restoration efforts carry some tremendous domestic and international implications in terms of both economics and ecology;
2. The acquisition and processing of a large number of satellite images and the development of an erosion simulation model have taken more time and effort than expected, but significant progress has been made;
3. Collaborating with Chinese scientists is very beneficial, but it takes a lot of efforts to establish and function;
4. Done properly, the Chinese government is willing to listen to what's been suggested by international research, and is thus willing to take actions in improving its policy, which suggests that projects like this can and will make a significant impact;
5. Assessing the environmental and socioeconomic impacts of China's ecological restoration programs will lay a solid foundation for ecosystem services evaluation and compensation, which will offer some great follow-up research opportunities.

Publication efforts:

Our research findings were reported at an international symposium organized by the PIs and their Chinese collaborators last October in Beijing, which attracted a large domestic and international audience. Based on that event, the PIs have been editing a journal special issue in *Environmental Management* and a book to be published soon. Here is a list of the manuscripts:

1. China's ecological restoration programs: Initiation, implementation, and challenges
2. Assessing China's ecological restoration programs: What's been done and what remains to be done?
3. A methodology for integrative assessment of China's ecological restoration programs
4. Land cover changes in northeast China from late 1970s to 2000s
5. Quantifying terrestrial ecosystem carbon dynamics in Jinsha watershed, upper Yangtze, China from 1975 to 2000
6. Process-based soil erosion simulation at the regional scale – the impact of ecological restoration in Chinese Loess Plateau region
7. The driving forces of land-use and land-cover changes in the upper Yangtze basin
8. Cost effectiveness of payments for ecosystem services with dual goals of conservation and development
9. Agricultural productivity changes induced by the Sloping Land Conversion Program: An empirical analysis of Wuqi County
10. An estimation of the effects of China's forestry programs on farmers' income
11. An evaluation of the impact of the Natural Forest Protection Programme on rural household livelihoods
12. An empirical analysis of effects of China's land conversion program on farmers' income growth and labor transfer

Project Title: A Computational Approach to Understanding the Dynamics of the Judicial System

Proposal Number: 0624067

HSD Emphasis Area: Dynamics of Human Behavior

Lead PI: Wayne McIntosh (University of Maryland)
Co-PIs: Cynthia Cates (Towson University), Jimmy Lin (University of Maryland)
Collaborators: Neil Fraistat, Matthew Kirschenbaum, Catherine Plaisant, Philip Resnik, Ben Shneiderman (all from University of Maryland)

Research Goals:

1. Previous research of judicial systems has faced a trade-off between large scale quantitative inquiries focused on readily-counted behaviors and smaller studies that allow closer examination of legal texts. This project will apply automated content analysis techniques to the study of the US Supreme Court, thereby potentially obtaining "the best of both worlds".
2. By viewing the legal system as an intricate and complex web of communication, this project aims to better understand the role and influences of various actors through analysis of written records. Those records include, for example, briefs written by litigants and other stakeholders and opinions written by judges and justices. This goal will be accomplished by drawing upon methods from computational linguistics and information retrieval, coupled with visualization techniques.
3. To support research, we will compile, organize, and annotate a large collection of legal documents associated with cases heard by the US Supreme Court over the last half-century.

Thematic Areas:
A key part of our project is the creation of a free, publicly-accessible, online "United States Supreme Court Text Collection" (SCTC). This collection will consist of all available Supreme Court of the United States (SCOTUS) opinions (~12,000), briefs (~22,000), and oral argument transcripts (~8000) from all SCOTUS cases from the beginning of the Warren Court (1953) to present. We are designing our database to allow for (1) instant batch downloading of all queried documents (2) in a variety of formats (3) with full control over the inclusion or exclusion (and location) of such things as headings, footnotes, and citations and (4) the ability to associate available metadata to the text content in a variety of ways, such as tagged and imbedded within the document files themselves or in separate files with unique identifiers to link them. While the immediate reason for creating the collection in this manner is to enable rapid document acquisition, formatting, and pre-processing for the array of analyses we will conduct in the project, we anticipate that the collection will impact legal research more broadly by enabling and encouraging other judicial scholars to incorporate digital text processing technologies into their research.

Methodologies:
We are taking a three-pronged approach to accomplishing our research goals:

1. Database and other infrastructure development to provide a foundation for subsequent work.
2. Application of automated text processing algorithms to analyze collections and extract relevant features for human analysis.
3. Visualization of system output to facilitate rapid human comprehension of content analysis algorithms.

Recent Research Findings:

- We have been exploring the problem of visualizing "influence" within a text collection --- more generally, how the writings of different authors from different points in time are similar, and how "themes" or specific uses of language in particular contexts evolve over time. One simple example is the reuse of words from a previous document, with or without explicit citation, to convey a similar idea or to critique it. Together with Georg Apitz (Ph.D. student, Computer Science, UMD) and Ben Shneiderman (Professor, Computer Science, UMD), we have developed a prototype exploratory search interface that helps legal scholars detect, track, and analyze patterns of influence between actors in a text collection. In July 2007, Georg Apitz successfully defended a dissertation proposal on this topic. Components of his research include:
    - Creation of a visual language that describes how content propagates within text collections.
    - Development of general temporal patterns of influence, showing under what circumstances they work and do not work, and showing how they transfer between collections.
    - Empirical demonstration of how patterns of influence help experts understand text collections and find important information that is otherwise hidden or extremely tedious to find.
    - Design of an application that serves as a central workspace for scholarly research and elucidation of the underlying design principles.
- We have been applying automated linguistic analysis techniques to transcripts of Supreme Court oral arguments with Tim Hawes (Ph.D. student, Linguistics, UMD) and Phillip Resnik (Associate Professor, Linguistics, UMD). This work explores the hypothesis that justices' verbal behavior offer insight into their decision making processes (in the simplest form, their votes). Going beyond simple word-level features, we are examining rich syntactic and discourse-level cues that can give us insight into unobservable properties of justices. Preliminary findings:
    - Use of basic features, including word counts and document length, for document classification by each justice's vote appears to be insufficient to exceed the baseline established by a justice's bias for or against the petitioner.
    - However, the inclusion of linguistically-informed features for sentence complexity and stylistic choices has yielded preliminary results that are in excess of the baseline for the majority of the justices tested.
- We have also begun analysis of opinions authored by Justices Antonin Scalia and Stephen Breyer. We use a variety of computer assisted text data analysis techniques to assess all non-majority opinions authored by either Justice from his first year on the bench through 2006. We hypothesize that just as the two Justices are distinguishable by voting patterns, they are also distinguishable by interpretive language that is both general and issue-specific. Moreover, while the normal contention by attitudinalists is that the language of judicial opinion is often misleading/insincere, we are assessing their opinions for evidence that the justices actually reveal ideological bias with the words they use. Preliminary findings:
    - As expected, Justice Scalia endorses textualism as the best method of judicial analysis, while Breyer espouses a structural approach to the decision process. However, the extent to which each Justice employs his self-declared methodology varies with the legal issue at hand.

Challenges and Opportunities:

We have established collaborative ties to other units on the Maryland campus that enhance our research. The Human-Computer Interaction Laboratory (HCIL) has expertise in the design of user interfaces, whose assistance has been valuable in guiding development of our prototype search tool. Maryland's Institute for Technology in the Humanities (MiTH) has a Mellon-funded project called MONK (Metadata Offer New Knowledge) that aims to help humanities scholars discover and analyze patterns in the text they study---the goals are quite compatible with our own and discussions have shaped our thinking in developing widely-applicable tools for different domains.

Project Title: Contending with Materiel Convergence: Optimal Control, Coordination, And Delivery of Critical Supplies to the Site of Extreme Events

Proposal Number: 0624083

HSD Emphasis Area: Decision Making, Risk, and Uncertainty

Lead PI: José Holguín-Veras, Rensselaer Polytechnic Institute
Co-PIs: Tricia Wachtendorf, University of Delaware; Satish Ukkusuri, Rensselaer Polytechnic Institute

Research Goals:

1. Integrate social science concepts that influence materiel convergence during disasters with engineering concepts related to dynamic needs and supplies of critical resources in the aftermath of an extreme event.
2. Determine hazard, communication, organizational, and demographic features that may impact material convergence and supply needs
3. Estimate the amount of critical resources available on site / in adjacent areas, i.e., what is available.
4. Estimate optimal pre-positioning strategy (in the case of anticipated extreme events).
5. Estimate the dynamic pattern of unmet needs, i.e., the difference between items (1) and (2) above. This provides estimates of what needs to be transported to the impacted area from elsewhere.
6. Ensure the models developed are consistent with social sciences' state of the art thinking.

Thematic Areas:

1. Disaster Management
2. Social Science concepts related to materiel convergence
3. Engineering concepts related to supply chain modeling

Methodologies:
Qualitative Analysis using In-depth Interviews and Document Analysis, Statistical Data Analysis, Network Modeling, Optimization Theory, Control Theory

Selected Recent Research Findings:
This research work addresses the problem of locating facilities which can be used to pre-position supplies in an area affected by a disaster. Our objective is to locate facilities which will minimize the response time. That is, all demand points in the affected area can be reached from a given facility in the minimum time possible. For this, we model the problem as a variation of the Uncapacitated Facility Location Problem (UFLP), where we seek to assign the demand points to a given set of facilities in such a way that the response time is minimized. We formulate the problem as a mixed-integer program. Instead of solving the non-convex optimization problem, we develop a heuristic algorithm by exploiting the geometry of the problem. The heuristic algorithm is based on the Vornoi diagrams. In this paper, our main contributions are three fold : (1) Contrary to traditional approaches for solving similar problems we provide a heuristic solution that exploits the geometry of the problem, (2) our results show that embedding the Voronoi diagrams (which has traditionally been used for the continuous version of the facility location) in our heuristic for solving a hard discrete problem provides close to optimal solutions in a reasonable amount of time, and (3) we provide an extensive evaluation of strategies for setting up the initial starting points for the heuristic. The development of such an algorithm can have important applications in the strategic location of warehouses for pre-positioning of critical supplies during disasters. In addition, we also provide specialized techniques to generate the initial starting points. Since global solution is not guaranteed by the standard solvers, we compare out results with a state of the art global optimization solver, BARON. Finally, a real world application of the proposed heuristic is conducted for pre-positioning facilities using data from Hurricane Katrina. The results

from the heuristic show that we can reduce the response time by as much as 25 percent. The proposed approach has the potential to significantly improve the efficiency of distributing critical supplies in disasters.

Network visibility – determining which groups are part of the response network and the roles they play – is a key challenge in coordinating the emergency supply flows after a major disaster event. Based on research conducted following Hurricane Katrina, we found that although formal response plans outline many roles and organizational actors within the supply chain network, individual actors are sometimes unaware of those roles. Emergent groups frequently become part of the system and established organizations sometimes take on new tasks related to materiel supplies. In catastrophic events where convergence and emergence may play an even larger role than in typical disasters, network visibility becomes even more essential.

We propose that there are several ways to facilitate networks visibility. First, organizations can be identified during non-crisis periods that can serve as information bridges between smaller clusters of organizations within the overall response network. However, the building connections or ties between organizations must be accompanied by strategies to make them visible for both existing members of the response networks as well as those organizations new to it. Second, pre-event community partnership building can work to incorporated groups not traditionally involved in disaster response, providing an alternative perspective on needs and resources as well as foster awareness of potential roles. Third, developing open system technology platforms that better visually represent emergent networks could serve as a useful information communication tool in the same way the Geographic Information Systems have advanced emergency management information processing of location-based information. Of course, technological solutions have their limitations. We outline several specific issues that must be considered alongside any technological strategies.

Publications/Presentations:

Publication: Yushomito, W., Ukkusuri, S.V. and Jaller, M. A Vornoi based Heuristic for the Facility Location Problem with application to Hurricane Katriana. Submitted for Publication in Journal of Transportation Research Record. 2008.

Wachtendorf, T., B. Brown, J. Holguin-Veras, and S. Ukkusuri. 2008. Network Visibility in Emergency Supply Chain Management. Paper accepted for presentation at the workshop Improving Disaster Supply Chain Management: Key supply chain factors for humanitarian relief, Stephenson Disaster Management Institute/ISDS Department of Louisiana State University, Baton Rouge, LA., November 16-18.

Wachtendorf, T. (Under Review). Logistics section of Session 7: Logistics, Critical Infrastructure, and Public Health. Instructor's manual for a course on Catastrophe Readiness and Response, Emergency Management Institute Higher Education Project.

Challenges:

- Acquiring data from agencies in the form/quantities to support both disciplinary needs
- Additional time necessary to negotiate different methodological approaches
- Sustained graduate student interaction across disciplines/institutions

Opportunities:

- Faculty presentations to graduate students of other disciplines at their respective institutions
- Involvement of graduate and undergraduate students on critical research tasks.
- Co-authored multi-disciplinary papers/presentations
- Outreach to scholars working on similar issues in India and China.

Project Title: Disaster, Resilience and the Built Environment on the Gulf Coast

Proposal Number: 0624088

HSD Emphasis Area: Agents of Change

Lead PI: John R. Logan, Brown University
Co-PIs: Jack Mustard, Phil Brown, Rachel Morello-Frosch, Steve Hamburg, Scott Bell

Project Goals:

- With respect to the Katrina/Rita hurricanes: to determine 1) the extent of recovery in New Orleans and the Mississippi Coast, 2) the national pattern of displacement of residents and their assimilation into other places, 3) the redistribution of population by race and class within the New Orleans metropolitan region, and 4) the nature and effectiveness of neighborhood participation in redevelopment decisions.
- With respect to the Gulf Coast: to assess the cumulative storm risk on the Gulf Coast (from Texas through Alabama) during the last fifty years, and determine how the natural environment (forest cover) and the built environment (residential land use) have been affected by these events.

Thematic Areas:

- Impacts of natural disasters
- Population distribution and migration
- Regional development patterns

Methodologies:

- Economic and demographic analysis in a GIS framework
- Remote sensing of vegetation
- Community-based fieldwork and personal interviews

Recent Research Findings:

The most recent analysis at the county level compares the extent of damage and recovery of population and vegetation following Katrina and Rita. In most dimensions there is a very close spatial association with the footprint of the hurricanes, as well as a clear impact and recovery profile over time. The principal differences are important: 1) the population impact had a much greater geographic extent than the impact on vegetation, and 2) the recovery of vegetation was much more rapid and up to now more complete. A major source of these differences is that the human population shifts included significant displacement to other areas, a phenomenon that has no parallel in the forest environment.

Challenges and Opportunities:

Katrina is the natural event with the most far-reaching impacts on the U.S. population in this generation. A scientific understanding of its effects will be valuable for public policymaking, both in the short term (investments in the region over the next several years) and in the long term (planning for the security of coastal zones). The project will also provide information from models of wind damage and flooding, direct measures of forest cover, and population distribution in an integrated GIS database that can be of use to future studies. Developing time series models that take spatial effects into account and that cross physical and social science indicators requires a high level of interdisciplinary communication.

Project Title: Dynamics of Social Networks

Proposal Number: 0624116

HSD Emphasis Area: Dynamics of Human Behavior

Lead PI: Hernan A. Makse, Levich Institute and Physics Dept, City College of New York, CUNY, New York, NY
International Partners: F. Liljeros, Dept. of Sociology, Stockholm University, Sweden**;** M. Batty, Centre for Advanced Spatial Analysis, University College London, UK**;** S. Havlin, Dept. of Physics, Bar-Ilan University, Israel

Project Goals:
- Classification of social networks based on the fractality measure
- Understanding the modular structure in societies
- Influence of the modularity on immunization processes
- Dynamical laws of evolution for social networks
- Towards universal laws for all complex networks

Thematic Areas:
- Social networks
- Complexity
- Urban dynamics

Methodologies:
- Scaling theory
- Database analysis
- Computer simulations

Recent Research Findings:
This project brings together ideas from Statistical Physics and Network theory for the analysis of large-scale social network databases. We use a number of different databases, such as interactions in an online community (qx.se), relations, residences and workplaces in Sweden, and the distribution of population.

Our recent findings include the following:

a) *Networks classification*
We recently published a paper in Physical Review Letters, where we develop an analytical theory for the study of degree-degree correlations in social and other systems. We were able to construct a novel phase diagram, where social networks are shown to be placed in a different area than networks in biology and technological networks. This diagram is based on a newly-introduced correlation exponent which can be shown to depend on a combination of the scale-free character and the self-similarity property of a given network.

b) *Self-similar nature of human activity*
Human dynamics is reflected in many social, technological, and economic systems comprising complex and non-trivial properties originated in individual and collective behavior. In particular, activity such as sending emails occurs in bursts, i.e. clusters of high activity are separated by periods of low activity. Since these patterns cannot be explained by a purely random process, the mechanisms behind them are object of intense research, hunting for the basic laws of human activity. We investigated the possibility of long-term memory in the individual human activity of sending messages in online communities and uncovered pronounced auto-correlations following a power-law decay on time scales at least up to months. This means that individual human activity is governed by long-standing memory beyond daily or weekly cycles. In addition, we

analyzed the activity fluctuations in the collective by considering as a growth process the number of messages each member sends between two times. We find that the growth properties are fully explained by the temporal correlations. We use a model based on an underlying long-term correlated process that consistently reproduces the correlations in the activity as well as the inter-event time statistics.

c) *Behavioral mechanisms in online interactions*
Using the logged activities of all members in two online communities, we studied a series of mechanisms that describe personal motives behind the establishment of relations. These mechanisms include structural hole (connect to distant agents), exchange (establish reciprocal relations), balance (connect to friends of friends), and collective action (become part of a group). We calculated the relative occurrence of each mechanism in the actions of the members, and for the entire community as a whole. The resulting percentages differ markedly from the ones corresponding to random choices, helping us to revealing the underlying organizing principles. In short, we have found that exchange and balance mechanisms are much more favored compared to the relative appearance of the structural hole mechanism. Another important finding is that the average behavior of a member changes markedly, as this member becomes more involved in the community. The initial dominance of the structural hole and exchange mechanism becomes progressively less important with the balance and collective action mechanisms mainly determining the behavior of the oldest members in the community.

d) *Cities*
An important issue in the study of cities is defining a metropolitan area, as different definitions can affect the statistical distribution of urban activity. A commonly employed method of defining a metropolitan area is the Metropolitan Statistical Areas (MSA), based on rules attempting to capture the notion of city as a functional economic region, and is usually defined empirically. The MSA method is time-consuming and is typically constructed only for a subset (few hundreds) of the most highly populated cities. We introduced a new method to designate metropolitan areas, denoted "City Clustering Algorithm" (CCA). The CCA is based on spatial distributions of the population at a fine geographic scale, defining a city beyond the scope of its administrative boundaries. We use the CCA to examine the City Size distribution, where there is a controversy whether it follows Zipf's law (power-law decay) or a log-normal distribution. We study the city size distribution and compare it to conventionally defined Metropolitan Areas with respect to a possible dependence on the burning parameter. The burning parameter corresponds to a coarse-graining and represents the maximum distances that can be bridged over still covering the same city, such as in the case of a highway or a large river. In this way we obtain a power-law distribution and find only a weak dependence on this parameter. In addition, we identify the optimal value which yields the closest results with conventional MSA.

Challenges and Opportunities:
An important task of the current project is to identify modules (cliques) in social networks and study the mechanism that drives a system towards a specific modular character. A very intriguing observation is that these modules appear to emerge at different observation scales. We are working towards developing novel module identification methods and models that can explain this scale-invariance of the modularity.

Understanding the driving mechanism behind this different type of modularity will allow us to apply our findings towards more efficient immunization strategies, which will take into account the specific network features of social networks.

In the study of behavioral mechanisms we try to understand the dynamics of creating friendships and (equally important) of destroying them in online communities. The detailed logged activities allow us to determine members whose patterns do not follow those of the majority. The main question is whether we are able to predict such patterns based on fundamental network features, such as the degree of a node or the amount of activity related to this specific agent.

Project Title: Collaborative Research: Decision-making, Risk & Uncertainty (DRU): Understanding mental models of expertise in construction management using interactive adaptive simulations

Proposal Number: 0624118

HSD Emphasis Area: Decision Making, Risk and Uncertainty

Lead PI: Amlan Mukherjee, Michigan Technological University
Co-PIs: Tristan Johnson, Amy Baylor, Florida State Universitu
Collaborators: Nilufer Onder, Michigan Technological University

Research Goals:
Develop a mathematical framework to represent construction process information and design algorithms that simulate possible project futures to estimate associated risk.
Develop interactive adaptive simulations based on the mathematical framework and construction management field data and use it to capture data on expert and novice decision-making.
Develop mental models of construction management decision-making under uncertainty, specifically highlighting differences between experts and novices in knowledge organization, information processing, and risk assessment.

Thematic Areas:
Artificial intelligence in decision support systems
Construction management simulations
Expert/novice cognition

Methodologies:
Representation and agent based reasoning about construction information using temporal constraint networks
Collection and organization of field data through structured surveys and interviews of practicing construction managers
Using interactive simulations to collect human decision-making data
Analysis of collected data using statistical and graphical methods

Recent Research Findings:
The findings from last year's research activities span theoretical and experimental research. From an experimental standpoint, the research efforts completed the development and preliminary testing of an interactive situational simulation of a dynamic task environment that can be used to capture expert-novice decision-making data. A discipline was developed to capture human decision-making data from interactions within the simulation test-bed. From a theoretical standpoint the research developed the situational model framework and implemented it to analyze initial human subject data that was collected using the simulation test-bed.

Experimental Research:
The research laid the foundations for studying decision-making in complex dynamic construction management scenarios using situational simulations as experimental test-beds. We drew on research conducted in dynamic decision-making, construction data-mining and situational simulations to study human decision-making. The Interactive Construction Decision-Making Aid (ICDMA) was used as an experimental test-bed to collect data. ICDMA is a situational simulation of a real four-story steel frame office building construction project. Its ability to appropriately simulate the construction management domain was validated by soliciting and incorporating suggestions, and advice from experienced construction managers from Kiewit Engineering Services.

Research findings included the development of methods to handle challenges in the collection, organization and analysis of human subject data. A discipline driving the collection of human

decision-making data was developed; and semantics to organize the data, and a mathematical syntax to represent it were established. The significance of this discipline is that it can be used to collect and analyze decision-making data in any dynamic task environment – and can be applied to the study of decision-making in domains such as natural hazards management. (Watkins et al. 2008)[1]

Theoretical Research:
Literature studying the relationship between situational awareness, decision-making and expertise in complex dynamic environments, was investigated and a formal framework was developed to construct and measure knowledge organization patterns of expertise. Based on the notion that effective situational models lead to effective decisions, and that experts are effective decision-makers, we constructed situational models that can be used to specifically investigate the relationship between situational awareness and expert performance.

We define situational models as transient internal organizations of information that decision-makers in dynamic complex environments use to comprehend a scenario and formulate effective decisions. A situational model is based on situational awareness, and mental models of the knowledge domain. Situational awareness provides decision-makers with scenario specific information that is necessary for effective decision-making. Mental models of the domain provide them with a schema to organize the situational information and create a situational model. Situational models of decision-making can be measured using a framework that was developed. The framework is founded in temporal representation of situational information in the simulated environment, and the representation of human decisions using the mathematical syntax that was developed within the experimental discipline (Watkins & Mukherjee 2008)[2].

The discipline was implemented to collect human subject decision-making data through preliminary experimental work. The theoretical framework developed, was applied to statistically analyze the data collected within experimental test-beds such as ICDMA. Preliminary efforts have been made to analyze the data to discover patterns in complex construction decision-making. Specifically the analysis has focused on developing associative models reflecting underlying cognitive structure driving decision-making by tracing temporal lags between when a decision is made, and its impacts on fast evolving crisis scenarios at hand.

Challenges and Opportunities:
Some of the primary challenges that will need to be addressed are methodological, analytical and practical. Methodologically, the data framework developed to represent and formally analyze human subject data will have to be further validated to ensure that it is sound and capable of capturing complete relevant information. Analytically, a suite of multivariate statistical analysis techniques will have to be incorporated into the framework, to afford the ability to generally analyze human decision-making data in various dynamic task environments. From a practical standpoint, the primary challenge at hand is to collect human subject data by involving a significant number of experts from the industry. Even though the project has had significant support from industry, it is a challenge to get busy construction managers to commit 3-hour blocks.

The experimental discipline and framework to represent and analyze human decision-making data in interactive simulation testbeds opens up the opportunity to study critical questions about

[1] Watkins, M., Mukherjee, A. & Onder, N. (2008) Using situational simulations to collect and analyze dynamic construction management decision-making data. *In Proceedings of the Winter Simulation Conference (ACM/SIGSIM), 2008.*
[2] Watkins, M. & Mukherjee, A. (2008) Using adaptive simulations to develop cognitive situational models of human decision-making (Accepted) *Technology Instruction Cognition Learning, Expected 6(3)*.

human decision-making in dynamic task environments, such as: (i) When making decisions under uncertainty in domains with limited information, how do decision-makers establish priority - and how do alternative decisions evolve over time? (ii) What is the minimum amount of information that is necessary for effective decisions in dynamic task environments?

The situational simulation, ICDMA, also provides the opportunity to improve undergraduate construction education, by providing students the ability to authentically participate in construction decision-making, and explore the consequences of their decisions.

Project Title: Social Network Dynamics of Youth

Proposal Number: 0624158

HSD Emphasis Area: Dynamics of Human Behavior

Lead PI: James Moody, Duke University
Co-PIs: Daniel McFarland, Stanford University; Scott Gest, Penn State University

Project Goals:
With this project, we attempt to build a richer portrait of youth networks by modeling networks across both an interactive and temporal dimension. With respect to social interaction, at the most micro-level we have face-to-face communications bounded within classrooms. We then extend to less-bounded within grade friendships and then finally to relations that cross multiple contexts. The second dimension focuses on the temporal expansiveness of relations. Face-to-face communications result in immediate networks bounded in time to the current moment. These expand in friendship to much longer time-scales. Movement across these two dimensions can be thought of as a general progression from strongly "bounded" to "unbounded" networks. This work extends across the fundamental dimensions of hierarchy/Inequality and group/cohesion. To do this, we are building new software for analyzing networks, compiling data for public use, and modeling these data. Our three main goals are thus:

1. Provide a new vision of the networked life of youth that captures the endogenous developmental trajectories of social relations and their intersection with life-course development.
2. Build new tools and provide sample data for mapping, measuring and modeling dynamic networks.
3. Provide theoretical plug-in points for network models that can extend network evolution to peer influence models of youth behavior and ideational diffusion.

Methodologies:
We use graphical representations, social network measurements and statistical models for networks to jointly describe the evolution of youth networks. To cover all scales, we build similar models on multiple data sources that, combined, will form a pastiche portrait of the evolutionary sequence of youth networks. Our methods include exploratory visualizations, particularly network "movies" that allow us to watch a network evolve over time. Our focus for standard measures is on centrality, triad distributions and movements across groups over time. We cluster networks to find peer groups, build local-network sequences of local relational patterns and then fit exponential random graph models (ERGMs) for each setting.

Recent Research Findings:
Our work has progressed on three fronts: tools & methods, data construction, and network modeling. With respect to tool building, we have added a group-boundary indicator to the Social Network Image Animator (SoNIA), that allows one to identify changes in group structure over dynamic movies. This would was presented at the Sunbelt social networks conference. We have developed a new set of static representations for dynamic networks (Moody, UR), which allows consistent comparisons across dynamic datasets. Our interest in modeling real data has generated deep concerns with data quality, and we have now added an analysis of the effects of missing data on network measurement (Moody & Smith, in progress). With respect to data construction, we have compiled our core data sources making them amenable to modeling and measurement, a key step in prepping data for public use. Our measurement and modeling directions have proceeded in two directions. First, with colleagues and students we have started identifying how network dynamics plug into models for social behaviors. Gest and colleagues are taking the lead in this direction. This work, consistent with cognitive network studies, finds that high centrality actors have the most accurate perceptions of the network. This feeds into our other finding that academic adjustment relates to both network socialization (becoming similar to peers)

as well as reputation and social comparison, which require a self-perception of the network. All of these conclusions require distinguishing selection from influence, which is being accomplished with detailed SIENA models for dynamic networks. Our more directly structural models have focused on forces driving network change over time using dynamic multi-level ERG models. Here we have found that endogenous structural features, such as seeking balance and homophily are consistently important for the formation of new friendships, even controlling for the (strong and consistent) effects of prior interaction. These effects are altered slightly by structural constraints (tracking, physical propinquity), but associations are remarkably stable. This stability hints at fundamental behavioral/developmental foundations to network evolution.

Challenges and Opportunities:
Our challenges have been practical and detailed, but they hint at important advances yet to be made in dynamic network modeling. First, while the ERGM framework allows for very general paramterizations, the estimation routines are finicky and somewhat cumbersome. Part of the difficulty is conceptual: our intuitive notions for the features that drive networks may simply imply impossible network configurations. But part is also methodological, involving identifying fast routines for well-specified models. The dynamic models for selection and influence, in particular, are difficult to scale across multiple large settings. We are confident these are temporary features, and that further advances in the modeling strategy will alleviate, but they are none-the-less real now. Second, as we move more deeply into the linked dynamics of relations (across relational types) and attempts to specify how relations are connected with behavior, issues of network time-scales quickly compound. For example, finding different effects of peer composition across genders can be a result of both developmental time-scale differences (maturity levels), but also differences in the temporal-relevance of relational change (adolescent boys may be more accustomed to rapid network turnover than girls, say). If so, can we find a timescale that optimizes network effects within gender? Or, should we construct network indices with different time-windows? Expanding this notion leads us directly to questions about how best to represent dynamic networks in the most flexible way, so that researchers can accommodate theories of network change with internal variation in network tempo.

Current Papers (published last year or in progress this year)

Bender-deMoll, Skye, Martina Morris and James Moody. (2008) “Prototype Packages for Managing and Animating Longitudinal Network Data: dynamicnetwork are rSoNIA” *Journal of Statistical Software*

Davidson, A. J., & Gest, S. D. “Dynamic associations between children’s social knowledge and social status in the peer network across the upper elementary school grades. (under review *Social Development*).

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Project Title: A longitudinal analysis of the social dynamics of environmental equity in Baltimore

Proposal Number: 0624159

HSD Emphasis Area: Agents of Change

Lead PI: Christopher Boone, Arizona State University
Co-PIs: Geoffrey Buckley, Ohio University; J. Morgan Grove, USDA Forest Service; Charles Lord, Boston College; Austin Troy, University of Vermont

Project Goals:

- To examine spatial patterns of environmental equity, defined by access to environmental amenities and disamenities, over the long term and to measure the spatial correlation with race/ethnicity and socioeconomic status
- To link patterns to processes by examining the social and institutional dynamics that drive patterns of amenities, disamenities, and neighborhoods
- To ascertain if threshold densities or rates of change in densities of amenities and disamenities explain shifts in population characteristics over time.

Thematic Areas:

- Environmental equity
- Land use dynamics
- Institutional analyses

Methodologies:

- GIS and spatial analyses (park services areas, geographically weighted regression, dasymetric mapping)
- Examination of spatial patterns in case law, zoning variances, nuisance petitions, and ordinances relating to unwanted land uses over time
- Examination of federal, state, and local institutions over time that impinge on land use

Recent Research Findings:
Completion of critical data sets has allowed the team to conduct some analyses on the distribution of parks, our chosen environmental amenity for this project, in relation to where social groups live. This builds on prior work that examined the distribution of Toxics Release Inventory sites as our chosen disamenity. So far, we have conducted these analyses for the years 1990 and 2000, but we have begun analyses backward in time. The most recent research finding concerns the distribution of parks in relation to racial and income groups for the year 2000. We employed a new approach, the parks services area (PSA), which uses Thiessen polygons to delineate catchment areas for the closest park for each area in the city, in combination with dasymetric mapping to reapportion census data to residential land use polygons. Using these methods, we found that PSAs that are predominantly black have higher park congestion than areas that are predominantly white, although differences are less apparent at the city level than the metropolitan level. On average, PSAs that are greater than 75 percent African-American have 4,788 ppa (median of 1,113 ppa), while PSAs that are greater than 75 percent white have 890 ppa (median of 118 ppa). Assessed property values are not significantly correlated with potential park congestion.

Using a 400 meter buffer as acceptable or desirable walking distance, we found that a higher proportion of African Americans have access to parks within walking distance than whites, but whites have access to more acreage of parks within walking distance than blacks. Park acreage per capita is also strongly correlated with income. Using parcel-level data, we analyzed age and value characteristics of properties within and beyond a quarter-mile from parks. Of the 860,000 residential property parcels in Metropolitan Baltimore, 225,000 or 26.2 percent had their centroids within a quarter-mile of at least one park. Analysis using the property parcels shows that

residents within a quarter-mile of parks tend to live in houses that are older and have lower market values than those beyond the quarter-mile. For properties with access, the mean and median year built are 1952 and 1955, while for properties beyond the quarter-mile the figures are 1966 and 1972. The mean and median market value for properties with access is $138,399 and $91,360, while for properties without access the values are $191,694 and $149,160. Parcel density is also significantly and positively associated with access. In general, these figures confirm mapped patterns for Baltimore: poor, inner-city minority residents tend to have better access to parks, but white, wealthier suburban residents tend to have access to more acreage per person.

A needs-based assessment – defined as the car-less, the elderly, children, and low-income households – finds that areas with the highest need have the best access to parks but also have access to less acreage of parks compared to low-need areas. A little over 60 percent of all census tracts have their population centroid within a quarter mile of at least one park. Using these selection criteria, nearly 70 percent of the highest need census tracts have access to parks, compared to 57 percent for the lowest need census tracts. Another way of measuring equity of access is to calculate the distance from the population centroids of high-, medium-, and low-need census tracts to the closest park. The results show that high-need areas are best served in this regard. The mean distance for high-need census tracts is 239 meters, well within the 400-meter standard, while the maximum distance is 1,224 meters. For the low-need census tracts, the mean distance to the closest park is 864 meters and the maximum is nearly 6 kilometers. Only 19 of the 127 high-need census tracts are not accessible to a park. This represents 74,733 people out of a total of 320,181 in high-need census tracts. A population-weighted mean distance shows similar results. For the low-need census tracts, the mean distance is 873 meters, for the medium-need it is 477 meters, and for the high-need it is 252 meters.

Analysis of documents from the 1930 through the 1950s, a period of rapid population growth and significant land use change in Baltimore, show that a number of institutions and tools – in particular, segregation ordinances, racial covenants, improvement associations, the Home Owners Loan Corporation, and the Parks and Recreation Board – systematically reinforced residential and occupational segregation and in doing so created separate black spaces in the city historically underserved with parks. Ironically, these mechanisms ultimately fueled middle class flight and suburbanization and black inheritance of much of Baltimore's space, including its parks.

Work is underway by the legal team to assess if the zoning variances and nuisance decisions over the past 70 years show any spatial or social bias. These data will be combined with the institutional documents and maps to assess the spatial configuration of decisions related to housing and environmental amenities and disamenities.

Project Title: Societal Implications of Individual Differences in Response to Turbulence: The Case of Terrorism

Proposal Number: 0624165

HSD Emphasis Area: Agents of Change

Lead PI: Roxane Cohen Silver, Department of Psychology and Social Behavior, University of California, Irvine
Co-PIs: George Shambaugh, Department of Government & School of Foreign Service, Georgetown University; Richard Matthew, Dept. of Planning, Policy & Design, Univ. of California, Irvine
Collaborators: Scott Blum, University of California, Irvine; Dana Garfin, University of California, Irvine; Paloma Gonzalez, Georgetown University; Bryan McDonald, University of California, Irvine; Michael Poulin, SUNY Buffalo

Research Goals:

1. To link psychological research on individual and group responses to traumatic life events to social science work being conducted on the security implications of global change and its effects on democracy. We believe it is important to weave these two strands of research together to investigate the extent to which individual responses to traumatic events and perceptions of global threats may evoke different political responses that in aggregate can influence democratic values, institutions and practices.
2. To evaluate the political impact of the ongoing psychological response to terrorism. What is the impact of ongoing fears of terrorism on the public's willingness to support vs. resist anti-terrorism measures?
3. To explore the relationships among (a) aging and age cohorts; (b) individual interpretations of and responses to security-relevant forms of global turbulence and transformation; and (c) social and political outcomes such as changes in support for or protest against the use of force abroad, attitudes towards surveillance at home, and one's level of trust in government.

Thematic Areas:

1. Transnational threats in general and global terrorism in particular
2. Individual responses to traumatic experiences in general and responses to a collective trauma such as a terrorist attack in particular
3. Collective public policy impact of individual responses to terrorism (e.g., support for the use of force, conscription, and other security-related issues)

Methodologies:

Using an anonymous Web-based survey methodology, we collected data on a nationally representative sample of US adults (N=1613, 73.5% response rate) during a 3-week period (December 28, 2006 - January 18, 2007) and again one year later during an 8-week period (N=1157, 71.7% response rate, December 28, 2007 – February 19, 2008). All participants in the second survey responded to the first survey as well. The study sample were adult members of a nationally representative, Web-enabled research panel established by Knowledge Networks, Inc. (KN) who were randomly selected from those individuals who had been on the panel for under six months and invited to participate in our research. The KN panel is developed using traditional probability methods for creating national survey samples and is recruited using stratified random-digit-dial (RDD) telephone sampling. To ensure panel representativeness, KN provides households who do not already have Internet access with free Web access and an Internet appliance that uses a telephone line to connect to the Web using the television as a monitor.

Recent Research Findings:
The level and impact of psychological distress and post-traumatic stress syndrome related to 9/11/2001 decreased between 2007 and 2008, but 14.9% of the U.S. public continues to report moderate to high level of psychological distress and 8.1% continue to report moderate to high levels of PTSD related to 9/11/2001. Higher levels of psychological distress are associated with a negative general outlook including a greater assessment of turbulence in the world today, pessimism about the economy and security environment, less trust of the government, less optimism about policy responses to terrorism and environmental disasters, less willingness to support of specific policies like staying in Iraq and more support for diplomacy. Higher levels of PTSD are associated with increased perceptions of national and personal risks from terrorism, greater political salience given of terrorism, greater support for aggression and unilateralism in foreign policy, as well as greater trust in government, acceptance of torture, willingness to give up civil liberties for the sake security, and optimism about the future security outlook.

Partisanship is a significant factor in determining perceptions of risk and assessments and support for policies regarding terrorism and environmental disasters. Republicans perceive the national and personal risk from terrorism to be higher than others, they assign greater political salience of terrorism, and are more supportive of the use of force, torture, intervention, and unilateralism; the express greater trust in government greater trust in government, are more willing to give up civil liberties for security, are less casualty sensitive and are more optimistic about the economic and security outlook and the overall direction of the country.

Age is associated with higher perceptions of personal and national risk from, and greater political salience given to, terrorism. Older people are also more supportive of government policies overall, but are not significantly different than others when assessing specific policies such as the use of force, diplomacy, or torture. Exceptions to this include a greater willing than younger people to give up civil liberties for the sake of security and a stronger belief that immigration restrictions enhance security. Older people are more trusting of information provided by the government and are more willing than others to give up civil liberties in the name of security, but more distrustful of the willingness of politicians to exploit traumatic events for political purposes.

In terms of specific issues, 77% of the public continues to agree that terrorism is a threat to national security. This perception did not change significantly between 2007 and 2008. There was a dramatic decline in the percentage of people who considered the odds of an attack to be a greater than 50-50 change of an attack, from 31.2% in 2007 to 21.1% in 2008. The perception of a terrorist threat to personal security continues to be much lower and is also declining, from 5.7% agreeing that there is a more than 50-50 change of some one close to you being hurt in 2007 to 5.0% in 2008.

The political salience of terrorism remains high, but is decreasing with the proportion of people who reported terrorism as affecting their political views decreased from 64.2% to 46.5%. When asked about the importance of issues in the 2008 election, 69.7% cited the economy as important, while 64.2% cited Iraq, 62.9% cited terrorism, 61.3% cited immigration, 49.6% cited weapons proliferation, and 25.4% cited the environment.

The public continues to give the government poor marks in its response to terrorism and environmental disasters, with only 28.7% saying that they are satisfied with the way the government responded to 9/11. The public also remains distrustful of the government, with only 22.2% of the public agreeing that the information it provided about 9/11 is objective and can be trusted; only 15.1% trust information being provided about Iraq, and only 10.9% trust information being provided about Iran.

The percentage of people willing to give up civil liberties for the sake of national security declined from 42.6% to 39.0% between 2007 and 2008. At the same time, people are become less causality sensitive and more are willing to stay in Iraq until U.S. policy goals have been accomplished.

Finally, the public's assessment of the country's overall trajectory remains poor and statistically unchanged between 2007 and 2008 with 71.8% of the population arguing that things in this country have gotten off track. Reflecting this malaise, public support for President Bush has declined from 40.1% to 32.9% of our sample.

Challenges and Opportunities:
The links between terrorism-related distress and policy attitudes is a promising avenue for further investigation. Over the next year, our research team will follow this sample to collect longitudinal data about changes in political opinions and responses to terror. We will conduct these annual assessments at the end of each calendar year to benefit from changes in the political landscape over time. By combining forces and conducting survey research with questions regarding social psychology and political behavior, future analyses will seek to enhance our understanding of how profound global changes affect different groups of people, and why these groups respond differently in the political arena.

While we use the threat of transnational terrorism as the primary example of global turbulence and transformation, we believe the findings generated by our research are equally relevant to issues such as infectious disease, severe weather events, and transnational crime.

Project Title: The Role of Natural Resources in Mitigating Political, Environmental, and Health Shocks to Extremely Poor Households in Southeastern Africa

Project Number: 0624168

HSD Emphasis Area: Agents of Change

Lead PI: Frank Merry, Woods Hole Research Center

During the summer we conducted additional field work in support of our historical and cultural basis of resource use decisions. We spent 3 weeks in Cheringoma district, focusing on localities of Tsotse, Dimba, Chite, Muanandimae. The team included Heidi Genegnbach and project assistant Maria Bowman plus 3 Mozambican research assistants: Cardoso Henrique Meques (Universidade Pedagógica—Beira), Ricardo Muchanga (Universidade Católica de Moçambique), Ana Sofia Boroma. They conducted 23 individual and group interviews with district officials, non-governmental organizations, chiefs, spirit mediums, church leaders, merchants, male and female farmers (total 45 people). Additional focus was placed on a mini-survey to assess bicycle ownership and use in households in Tsotse. We also collected district-level government reports and documents on agricultural production, trade, natural resource use, environmental planning, commercial forestry, sport hunting in Cheringoma, and obtained customized district maps showing soils, land use, hunting concessions, administrative divisions, health & education infrastructure, roads & railroad, etc.

We continued our library & archival research focusing on regional history of rural livelihoods and natural resource management with focus on Cheringoma district, ca.1600 to the present—includes primary and secondary sources (in Portuguese, French, English) on agricultural production, trade, forest resource use, flora and fauna, climate, health, settlement patterns, migration, land & timber concessions, hunting reserves, protected areas, political conflict, demographic trends, etc. This has lead to a substantial bibliographic database of primary and secondary sources on environmental history of central Mozambique and comparative scholarship on rural livelihoods and natural resource use now contains approximately 520 items

A preliminary analysis of fieldwork has focused on understanding gendered patterns of rural livelihood diversification in present-day Cheringoma in the context of local histories of food and cash crop production, forest management, trade, and institutional/political conflict over natural resources during the pre-colonial, colonial and post-colonial periods—findings indicate mounting tensions between farmers and government/private sector over forest access and enforcement of conservation/forestry laws; worsening feminization of rural poverty; severe marketing constraints and cash-poverty inhibiting small-holder agriculture and long-term food security even in areas of high production potential; dominance of barter/in-kind transactions over cash sale of crops, wild food sources, artisanal products, home-brewed alcohol; strong correlation between livelihood diversification *away* from own-food production and rising incidence (and severity) of alcoholism in rural households

Early results were presented at Workshop on Agriculture and Economic Development in Sub-Saharan Africa, International Institute for the Advanced Study of Cultures, Institutions and Economic Enterprise (IIAS), Accra, Ghana, 5 September 2008 (paper “Bees, Beer & Bicycles: Gender and Agricultural Diversification in Cheringoma, Mozambique”) and will be updated and presented again at Johns Hopkins University, African Studies Seminar, 3 October 2008

The next steps in the cultural research on resource use include transcription and translation of interviews from Sena/Portuguese into English, continued research in historical archives in Mozambique and Portugal, creation of project website to share findings and project materials with Mozambican counterparts, integration of results of socio-economic survey on Cheringoma district with qualitative historical material on livelihood diversification, food security, natural resource management, and poverty/welfare trends, third round of fieldwork in Cheringoma to conduct

interviews in additional localities (Mazamba, Nhansole, Maciamboze, etc) and follow-up surveys on household food and alcohol expenditures, non-farm artisanal production income, impact of Gorongosa National Park on livelihood strategies and food security

Last year we reported on the collection of 1,700 household surveys in the 4 districts surrounding the Gorongosa National Park. This data was randomly sampled and stratified based on road and population density. This data was then entered into an Access data base by students from the Universidade Pedagogica. Several of the students had participated in the data collection, while other had their first taste of the research while entering the data. More than 30 students and technicians received training in both Excel and Access in our on-going collaboration with local institutions. Once the data was entered, we transferred it into Excel. It was then distributed to partner institutions of the GNP and Cruzeiro do Sul, who will be using it in conjunction with our researchers. We will be presenting the results jointly next year in a meeting of local, regional and national government designed specifically around this data and funded through the Department of Environmental Action of Sofala Province. Although the collection conditions were extremely difficult, that data is of sufficient quality to allow us to conduct several interesting analysis concerning the economic of household decisions, natural resource use and perceived welfare.

Preliminary analysis shows that access of households to the park's wildlife resources (hunting, fishing) and fuelwood resources lead to significant welfare increases. Households near the park also seem to spend less time collecting fuels and food, increasing time for income earning productive activities. Welfare is measured as either income collected from productive activities or time spent in productive activities. Households near the park have greater income and more time to devote to agricultural production or off farm income earning activities. We are currently building an economic household model to answer several questions relevant to our proposal. The household model will specify formal linkages between household decisions involving labor, capital, and park resource use with characteristics of natural resource quality, demographic characteristics of households, and access to markets. Once built, this household model will be used to study the welfare effect of various shocks to household decisions, such as changes in park quality and access (such as planned extension of park boundaries), health, climate risk, and changes in market access. The importance of these shocks will depend on the costs incurred by households due to changes in decisions they must make to compensate. We expect that the ability to compensate and incur as little a reduction in income and welfare as possible will be higher for those households accessing the park directly. Finally, the benefits and costs of several policies aimed at smoothing the effects of shocks on household welfare will also be studied using the basic household model. This will involve estimating the marginal effect of policy-driven changes in income and markets to household decisions and ultimately welfare.

In support of the spatial analysis, work is largely completed on an effort to determine the rate and pattern of deforestation on Mount Gorongosa using a four-date (1972, 1992, 2000, and 2005) Landsat image time series spanning 30+ years. A segmentation-based change detection algorithm was used to compute the amount of tropical forest lost between each of three time-series intervals and the annual loss rate was estimated for each time period. Additionally, the Fragstats package was used to quantify the spatio-temporal pattern of forest fragmentation. Our results confirm that the rate of deforestation has increased significantly since the 1970s/80s (0.1%/yr), with the highest rate observed during the 2000-2005 time period (0.9%/yr). The results illustrate how remote sensing and GIS technologies provide an effective means with which to detect, monitor, and analyze landscape change for the purposes of informing analyses, forecasting threats, and supporting management decisions.

Finally, students in the Dartmouth Environmental Studies program continue to participate in the research producing an undergraduate thesis "Paying for Preservation: Eco-Philanthropy and the Conservation of Protected Lands" that was completed in June 2008 and received Honors from the Environmental Studies Program. Another student has conducted background research on the likely impacts that climate change will impose on rural communities in Southern Africa.

Project Title: Collaborative Research: A Study in the Dynamics of Human Behavior in Institutional Innovation and Learning

Proposal Number: 0624177

HSD Emphasis Area: Agents of Change

Lead PI: S. Saatchi, UCLA Institute of the Environment, JPL/NASA
Co-PIs: S. Pincetl, Institute of the Environment, UCLA & PSW, USFS; D. Pataki Dept. of Earth System Science, School of Physical Sciences /Dept. of Ecology and Evolutionary Biology, School of Biological Sciences, UC Irvine; J.D. Saphores, Dept. of Civil and Environmental Engineering/Dept. of Economics/Dept. of Planning, Policy and Design, UC Irvine

Research Goals:

1. Understanding how complex systems involving urban ecosystems, social organizations and individuals grow, learn, and change in reaction to climate change threats, local air pollution, or water scarcity.
2. Understanding how trees function in urban environments and the effects of afforestation in a Mediterranean climate.
3. Understanding the value of trees as reflected by real estate values.

Thematic Areas:

1. Urban Ecology.
2. Institutional learning.
3. Institutional change.
4. Environmental valuation.

Methodologies:

Interviews and institutional analysis. Literature review, participant observation.
Tree sap flow monitoring.
Air pollution monitoring.
Satellite imaging.
Hedonic pricing and econometrics.

Recent Research Findings:

1. Program interviewees have different interpretations of events.
   The MTI has a complex organizational structure, as shown in the diagram below, illustrating the implementation of governance approaches in an era of budget constraint. Over the past 24 months, MIT has also exhibited **Institutional Learning** evolved from its earliest inception, learning through experience. Program implementation has changed significantly since its inception. MTI has had to involve numbers of partners, primarily from the non-profit sector and is an organization that has a multiplicity of actors with divergent internal systems of organization (a city bureaucracy and a non-profit in our case), but who are interdependent and have overlapping goals.
2. Tree canopy is considerably higher in more affluent council districts of the city.
3. Sap flow sensors were used to measure transpiration in several commonly planted tree species in the Los Angeles urban forest. We found that California sycamore (*Platanus racemosa*), a native species that is currently very popular in new plants, has a very high rate of transpiration due to its riparian ecology. However, other tree species such as Canary Island Pine (*Pinus canariensus*), can use significantly less water and can survive without irrigation. The assumption that native trees require few resources and are more environmentally beneficial than non-native trees is likely incorrect with regard to irrigation of planted forests in Los Angeles. We estimate that planting a million trees will require 2-60 million gallons of water per day, depending on species and location.
4. Tree planting has a large cooling effect.

5. Using spatial regression models, we find that a medium urban tree (with a canopy that has a diameter of 30 feet) adds $230 to $280 to the value of a multifamily building, which is only a fraction of the value of an urban tree for a detached single-family house, according to the environmental economics literature. Irrigated grass areas are also found to be valuable, although slightly less so than trees of the same size.

Challenges and Opportunities:
The program we are studying has changed in unanticipated ways, including its management. This has made our access to decision makers more difficult, and has also meant that the group implementing the program is not meeting on a regular basis. After 2 years we are finally going to be able to present our preliminary research results, though we had planned to have regular meetings during the 3 years of research. It also means that decision making has become far more centralized, leading us to have to change our social science research methods to a coordinated network based approach.

Finding sites to deploy our sensing equipment has also taken time, though currently, we have all of the tree physiological sites we can handle. Finding a location to install a flux tower for meteorological has continued to be very difficult. To compensate for the lack of a tower location, we have installed more physiological monitoring sites than originally planned, and we have also been using remote sensing analyses to draw inferences about the role of the urban forest in surface air temperature.

Next steps for understanding the value of urban trees involve estimating spatial hedonic models for sales of detached family houses in Los Angeles.

Opportunities include expanding our research team to include Dr. Gillespie at UCLA Geography who is developing a GIS-based history of urban forestry in the city through digitizing aerial photographs. One of his students will also be comparing UFORE with STRATUM, tree valuation programs, to determine which is more accurate. Dr. Gillespie will also be creating posters about the MTI's tree planting for bus stops in neighborhoods where the city has been actively planting trees.

Project Title: Dynamics of Reforestation in Coupled Social-Ecological Systems: Modeling Land-Use Decision Making and Policy Impacts

Proposal Number: 0624178

HSD Emphasis Area: Agents of Change

Lead PI: Tom Evans, Indiana University
Co-PIs: Catherine Tucker, Burney Fischer and Emilio Moran, Indiana University; Kelley Caylor, Princeton
International Partners: Mateus Batistella, EMBRAPA - Satellite Monitoring, Campinas, São Paulo, Brazil; Alessandro Zito - StatSol - Soluções Estatísticas e Pesquisa de Mercado, São Paulo, Brazil; Sergius Gandolfi, BIOTA Program, University of São Paulo, Brazil; Daniel J. Hogan, Population Studies Center (NEPO), State University of Campinas, Brazil; Carlos A. Joly, BIOTA Program, University of São Paulo, Brazil; Juliana Farinaci, PhD student, University of São Paulo, Brazil

Project Goals:

- Document trends in land cover change (deforestation and reforestation) in the states of Indiana (US) and São Paulo (Brazil)
- Identify factors associated with the transition from deforestation to reforestation. Are similar or different factors correlated with shifts from deforestation trajectories to reforestation trajectories?
- Identify factors that contribute to self-organization and non-government organization (NGO) activities that preserve existing forest cover and facilitate forest restoration.
- Develop and test an agent-based model of land-cover change in the state of Indiana and the state of São Paulo, Brazil in counties with and without regenerating forests to explore social and biophysical drivers of reforestation.

Thematic Areas:

- Land cover change, reforestation
- Land trusts, Non-governmental Organizations
- Household land use decision-making
- Forest Transition Theory

Methodologies:

- Household survey analysis
- Remote sensing and GIS analysis
- Interviews with landowners and land trust organizations
- Agent based model of land cover change

Recent Research Findings:
We are now ~1.5 years into our 3 year project. During year 2 we have been conducting major household surveys in Indiana and São Paulo. We will complete the Indiana survey work in October 2008 and the São Paulo survey work in December 2008. In parallel we have been compiling comprehensive land cover analysis in both states and so our research results are focused on the land cover analysis at this time. Our work in the next year will integrate the land cover analysis with the household survey data.

Summarized Findings:

- The rate of reforestation in Indiana is declining and in some locations has stabilized.
- Reforestation has resulted in a decrease in forest fragmentation as new patches of forest fill in gaps in existing forested areas (1985-2006). The net result of this process has been an increasing forest patch size over time

- Land cover transitions were most dramatic in periurban areas. These areas experienced both deforestation and reforestation from 1985-2006, although the net trend in south-central Indiana is one of reforestation during this period.
- A preliminary analysis has indicated that the rate of reforestation on properties enrolled in the Conservation Reserve Program (CRP) is greater than the rate found on properties of similar type that are not enrolled. Recent data have shown that many CRP properties were not re-enrolled in the program but this trend is too recent to identify whether this will have future land cover implications.
- Methodologically, we have employed multi-seasonal classification techniques that have achieved new levels of classification accuracy. For the dates 1997, 2001 and 2006 we were able to achieve an overall accuracy that exceeded 98%. This high accuracy allows us to capture small changes in land cover change with great confidence.

Challenges and Opportunities:
One goal of our project is to conduct cross-site analysis between local level trends of forest cover change in Indiana (US) and São Paulo (Brazil). This presents both a challenge and an opportunity. Because the land ownership pattern differs between the two states, there are methodological challenges to compiling consistent spatial data. Because of data availability we have had to use different sampling strategies in these two locations. Still, the cross-site analysis presents a particular opportunity to test theories of reforestation in two distinct locations that are at different junctures of the forest transition curve.

Project Title: The evolution of our preferences: Evidence from primate trading behavior

Proposal Number: 0624190

HSD Emphasis Area: Decision Making, Risk, and Uncertainty

Lead PI: Laurie Santos, Department of Psychology, Yale University
Co-PIs: M. Keith Chen, School of Management, Yale University; Daeyeol Lee, School of Medicine, Yale University

Project Goals:

- To explore the evolutionary basis of human economic preferences.
- To determine whether other species share the pervasive economic biases that plague human choice and markets.
- To develop a behavioral methodology for examining economic preferences in non-human primate subjects.

Thematic Areas:

1. The evolution of cognition/comparative cognition
2. Decision-making under risk and uncertainty
3. Neuroeconomics

Methodologies:

- Our work uses the methodological logic of comparative cognition. Specifically, our work uses cognitive studies in non-human primates to learn more about human biases. Because other primates lack human culture and market conditioning, they can provide an important window into more phylogenetically ancient cognitive strategies still present in the human species.
- We have successfully introduced a fiat currency and token trading to a captive group of capuchin monkeys. We are now using this method in a series of studies to explore primate preferences over a range of economic problems typically used to investigate human decision-making.
- We are currently developing a computerized task to present similar choices over gambles to rhesus monkeys. The goal of this new methodology will be to allow for future neurophysiological investigations of primate behavioral biases.

Recent Research Findings:

The broad goal of the present project is to explore whether human behavioral biases—phenomena like our irrational reference dependence and aversion to losses— are shared with other primates. As we reported last year, our first set of studies has revealed that monkeys placed into an economic market behave rationally in many of the same contexts as humans—they obey price theory and make choices in ways that tend to yield the highest expected payoff. However, we've also discovered that this rational market choice seems to breakdown in many of the same ways as it does in humans. Capuchins monkeys appear to be just as loss averse as human consumers, despite the fact that they lack market training and experience with economic choices (see Chen et al., (2006) *Journal of Political Economy*). Our new work has also revealed that capuchins' biases affect the way they deal with risky decisions. This new work, currently under revision at *PLOS One,* has observed that capuchins shift their preference for risk depending on whether they are gambling over losses versus gains. Finally, we have discovered that capuchins show a market bias known as the endowment effect, the tendency to over-value objects that are owned. These new results, currently in press at *The Philosophical Transactions of the Royal Society*, show that monkeys are reluctant to trade owned objects for equally priced goods even when they are compensated for the cost of the transaction and the additional time it takes to engage in trade. Taken together, our findings to date suggest that monkeys share many of our human behavioral biases.

Challenges and Opportunities:
Over the next year, we plan to begin the next phase of this work, which aims to examine whether monkeys show other judgment biases as well (e.g., anchoring and availability, uncertainty aversion, etc.). Another challenge of the coming year will involve adapting our token trading methodology for use with different primate populations, particular rhesus macaque monkeys. The aim of this new method will be to import our studies into neurophysiological preparations. One of the opportunities of this new line of work is to explore the nature of human behavioral biases at the level of single neurons. Combined with fMRI approaches in humans, we hope to yield more insight into the way that different neural mechanisms govern and shape both rational and biased decision-making.

Project Title: HSD-DRU: The Role of Communication in the Dynamics of Effective Decision Making

Proposal Number: 0624191

HSD Emphasis Area: Decision Making, Risk, and Uncertainty

Lead PI: Michael Littman
Co-PIs: Richard Lau, Barry Sopher and Matthew Stone
Graduate Students: David Andersen (Political Science), Monica Babes (CS), Jeff Birchby (Economics), Michael Wunder (CS)

Project Goals:

- We aim to analyze the role of communication when a group needs to choose between proposals in a setting where each player has a different piece of information, position in a network, and interest in the outcome of the decision.

Thematic Areas:

- Computational Linguistics
- Decision Making in Groups
- Experimental Economics
- Negotiation
- Network Games
- Opponent Modeling
- Social Preferences

Methodologies:

- Laboratory Experiments
- Computer Simulations complementing lab experiments
- Conversational Agent Design

Recent Research Findings:
We have designed, prepared, and now pretested an experiment in which subjects in 5-person groups individually receive a random signal about the probability a proposal will prove to be successful. These signals are in turn randomly selected from distributions with means of .35, .45, .55, and .65. The group must vote whether to adopt the proposal or not. Groups are assigned to 1 or 4 different communication patterns varying with regard to which group members can communicate (via text chat) with which other members, and are given three minutes to "chat" with others in the group. After the three minutes are up, groups vote (via a simple majority rule) whether to adopt the policy or not. If groups decide not to adopt the policy, everyone in the group receives 50 points. If the group votes to adopt the policy, then one more drawn is made from the distribution to determine whether the policy "succeeds." Successful policies pay all players 100 points; unsuccessful policies pay all players nothing.

After four rounds or decision making, we introduce personal "biases" into the mix that reward or punish individual group members on the basis of whether the group votes to adopt the policy, irrespective of whether the policy succeeds or fails. In this first experiment, these personal biases are public knowledge---that is, every subject knows the bias of every member of the group. Four rounds are played with relatively small personal biases, while four rounds are played with relatively large personal biases. At the end of 12 rounds of decision making, the experiment ends and experimental points are translated into dollars. Subjects are paid between $5 and $25 dollars, according to their performances.

We are currently recruiting subjects for this experiment and thus have only pilot results so far. We hypothesize, however, that the different communication patterns will have their largest effects

when (1) the signals subjects receive are centered near .5, and thus what the best choice is not clear; and (2) when subjects have biases, and communication can be used to try to figure out how those biases are influencing the communications.

We are employing simulation methods to get a handle on the incentives and opportunities that underlie this experimental design. For example, we have demonstrated that when player biases diverge, there is a disincentive to accept a neighbor's communicated information at face value---players have an incentive to skew their reports towards their own biased values. An interesting result is that, on average, players with little or no bias benefit by listening to communication, even when communication is biased completely by neighboring agents. This result holds whether or not there are many neighbors with large bias. We plan to correlate these simulation results with the experimental data obtained from human subjects.

Using transcripts from a simple bargaining game used in prior human-subjects work, we have constructed a computerized conversational agent capable of exchanging messages and participating in this game with human players. The vocabulary and grammar of this agent are built entirely from the limited sample transcripts, making the machine utterances natural and understandable. We are exploring issues that arise relating the use of language to the rules people employ when deciding how to interact. Of particular interest are communication factors that influence someone's decision of how to weigh attributes such as fairness, trust, and emotional state when bargaining.

Project Title: Modeling Time, Space, and Behavior: Combining ABM and GIS to Create Typologies of Playgroup Dynamics in Preschool Children

Proposal Number: 0624208

HSD Emphasis Area: Dynamics of Human Behavior

Lead PI: William Griffin, Arizona State University
Co-PIs: Jennifer Fewell; Paul Torrens

Project Goals:
Investigate the origins of sociality.
Create new methodologies that combine behavioral observational data with GIS data
Develop computer simulations (agent-based models) of group formation in children

Thematic Areas:
Sociality
Computational Social Science
GIS

Methodologies:
Computer based behavioral observation
Agent Based Modeling
GIS

Recent Research Findings:
After shifting to the Tablet PC data acquisition (including GIS information) method, the data were very clean and continued to demonstrate good reliability (ranging from .70 to 1.00). The data collection protocol changed very little during the course of the first year, and as we shifted from palm pilots to Tablet PCs, reliability went up, data acquisition speed stayed about the same (with additional codes) and we were able to include GIS information. Moreover, by moving to a Tablet PC format, we were able to incorporate additional data entry rules into the open source software (written by the PI), thereby reducing substantially the number of data entry errors by coders. This reduces the cleaning time for the data and facilities near real-time (weekly) data analysis to assess group formation and shifting patterns. To date, we have over 50,000 data points.
In this second year of the study (pilot in year 1) we have successfully begun/completed: (1) building a database in Access for more efficient storage, retrieval, and querying; (2) coding the new behavior codes that we added last year; (3) data collection with our GUI interface on a Tablet PC; (4) data collection with maps and GIS methods; (5) we added a biologically based notion of resource acquisition into the data collection protocol; and (6) implementing a project website.

Challenges and Opportunities:
First, the large amount of data being acquired is forcing us to spend a lot of time developing database tools. Second, we are being forced to develop joint behavior and time-space theoretical models. Integrating geo-spatial information with behavior is not difficult – but putting it into an agent based model is requiring us to postulate the possible links between individual group characteristics, play propensities, play location, and timing.

Project Title: DRU: Inter-organizational decision making and organization design for improved ICT coordination in disaster relief

Proposal Number: 0624219

HSD Emphasis Area: Decision Making, Risk, and Uncertainty

Lead PI: Carleen Maitland, Penn State University
Co-PIs: Andrea Tapia, Penn State University; John Yen, Penn State University; Benita Beamon, University of Washington

Project Goals:

- To identify the organizational designs that improve decision making and coordination among humanitarian relief organizations
- To simulate complex and emerging relationships that influence decision making to understand the impact of organizational design
- To model the effects of improved decision making on humanitarian relief supply chain performance

Thematic Areas:

- Organization science in the domain of non-governmental, humanitarian organizations
- Artificial intelligence in the domain of emergent behaviors in an inter-organizational setting
- Logistics and supply chain modeling of the influence of information on humanitarian relief supply chains

Methodologies:

- Qualitative organizational analysis
- Agent-based computational simulation
- Mathematical and computational modeling

Recent Research Findings:
The COHORT project is being undertaken in three modules. In the first we have analyzed the organizational structures, interactions and coordination barriers in three humanitarian relief coordination bodies. The research finds that while non-governmental organizations (NGOs) are willing to coordinate on infrastructure-related information and communication technology projects, those more closely related to information sharing, such as shared database access are more challenging. Similar to other organizations, these organizations act to safeguard what is perceived to be strategic information, which in turn inhibits coordination improvements in the sector.

The second module is developing a multi-agent system to simulate emergent behavior between organization representatives within the coordination body. In particular, we are focused on the formation of teams for collaborative projects in the absence of traditional organizational hierarchies. To date the findings are limited to the framing of the problem and we find that whereas emergent behavior of large groups of individuals has been undertaken, the emergent behavior of agents that embody dual roles as individuals and organizational representatives (however outside the organizational bureaucracy) has yet to be explored. We expect that the agent architecture will be useful in a variety of inter-organizational contexts, integrating the individual and organizational influences on such behavior.

The third module involves modeling the performance of humanitarian relief supply chains. To date the work has generated humanitarian relief supply chain performance metrics, building on but differentiating from those found in commercial supply chains. Further results include a model for determining so-called ‘last mile’ humanitarian aid distribution through a modeling approach and a

formulation that optimizes resource allocation and routing decisions. The research has also tackled the facility location problem for humanitarian relief chains and has developed an analytical approach that enables relief practitioners to make efficient and effective facility location and stock pre-positioning decisions. The main contribution of this work is a maximal-covering type model that determines the number and locations of the distribution centers in the relief network and the amount of relief supplies to be stocked at each distribution centre.

Challenges and Opportunities:
In the third year the research will expand the organizational forms to include a coordination body with a less formal organizational structure. This case will represent the most extreme organizational context for coordination and thereby will test the validity of results from other organizational forms and enable further comparisons. The case will also generate data for validating the outcomes of the agent simulations concerning the implications of organizational design for decision making and coordination outcomes as well as the supply chain performance modeling.

Project Title: Collaborative Research: DRU: Hypothesis Generation and Feedback in Dynamic Decision Making

Proposal Number: 0624228

HSD Emphasis Area: Decision Making, Risk, and Uncertainty (DRU)

Lead PI: Cleotilde Gonzalez, Dynamic Decision Making Laboratory, Carnegie Mellon University
Co-PIs: Rick Thomas, University of Oklahoma; Robert Hamm, University of Oklahoma Health Sciences Center
Collaborators: Frank Papa, Texas College of Osteopathic Medicine

Research Goals:

1. Contribute to understanding two basic mechanisms of Dynamic Decision Making: Hypothesis Generation and Feedback.
2. Investigate Learning in Dynamic Decision Making: What makes learning difficult? How to improve learning?
3. How are hypotheses generated while cues of a situation evolve over time? And how feedback changes human learning.
4. To develop realistic medical content for a case presentation diagnosis and management microwold simulation tool called MEDIC.

Thematic Areas:

1. Performance of dynamic decision making tasks. The context used in this research is medical diagnosis.
2. Memory theoretic account of hypothesis generation and testing.
3. Instance-Based Learning. Learning to manage patients with diseases modeled in dynamic medical systems (in which one can both request information and perform actions which affect the state of the system, and in which the state of the system can change spontaneously reflecting intrinsic disease processes) – descriptive models, identification of normative shortcomings, learning.
4. Learning and feedback.

Methodologies:

We conduct this investigation using two main approaches: 1) laboratory studies with the support of computer simulations and learning tools and 2) computational cognitive modeling using two architectures previously developed by our team: HyGene (Thomas, Dougherty, Sprenger & Harbison, 2008) and cogIBLT based on ACT-R (Gonzalez, Lerch, & Lebiere, 2003).

Recent Research Findings:

- Recent findings indicate that a large majority of highly educated individuals are unable to interpret the behavior of simple dynamic systems, a phenomenon we denote as stock-flow failure.
- Follow up research indicate the medical students also exhibit the stock-flow failure and are unable to interpret very simple relationships of flows and stocks. For example, they are unable to interpret correctly how the amount of fluids in the body change with the inflow and outflow of fluids over time. The stock and flow failure for medical students as well as for the general public is difficult to overcome.
- There is a natural tendency of decision makers to search for information contingent on their currently held hypotheses – a process we refer to as hypothesis-guided search. If only one hypothesis is maintained in working memory (WM), then hypothesis guided search necessarily follows a positive-test strategy. However, if more than one hypothesis is being maintained in WM, then the decision maker can search for information that differentiates amongst the hypotheses under consideration. We argue that cuing alternative hypotheses so that they are maintained alongside the focal hypothesis in WM enables decision makers to select diagnostic information.

- In the situation where the diagnostic information available changes dynamically in response to physician queries or the spontaneous provision of information, both the sensitivity (probability of a finding, given disease A) and specificity (probability of not observing that finding, given a disease OTHER THAN disease A) of each potential finding may change, when other findings have been observed. The effect of such dynamic specificities can be easily accommodated using conventional Bayesian computation; however, the effect of such dynamic sensitivities presents problems. It is anticipated that physicians will have difficulty accommodating for either type of dynamic implications of information.
- Assuming diagnostic reasoning in a domain depends on acquisition of the knowledge of the possible diagnostic concepts. We investigated the effectiveness of different kinds of information about the diagnoses in promoting the acquisition of the concepts. It was found that information about a disease category's probabilistic prototype (list of possible findings with an indication of how frequently the findings occur with the disease), exposure to case examples, paragraphs of text book information, and explicit contrasts between the prototypes of confusable diseases all can contribute to disease knowledge acquisition, with the contrasts and the examples being the most effective.

Challenges and Opportunities:

- New findings can be used to improve the curricula in medical schools. Teaching students about the behavior of dynamic systems, probability and hypotheses generation can improve their understanding of such systems.

Project Title: Collaborative Research: Forced Migrants Living in Post-conflict Situations: Social Networks and Livelihood Strategies

Proposal Number: 0624230

HSD Emphasis Area: Agents of Change

Lead PI: Beth Mitchneck, University of Arizona
Co-PIs: Joanna Regulska, Rutgers University
Collaborators: Ronald Breiger (University of Arizona), Magda Grabowska (Rutgers University), Peter Kabachnik (College of Staten Island-CUNY), Ruth Mandel (University of London), Olga Mayorova (University of Arizona), Nana Sumbadze (Institute for Policy Studies, Tbilisi, Georgia), George Tarkhan-Mouravi (Institute for Policy Studies, Tbilisi, Georgia)

Research Goals

1. Analysis of the ways in which forced migrants in post-conflict situations, in particular internally displaced persons (IDPs), use social networks in the construction of livelihood strategies.
2. Analysis of the extent to which social networks and livelihood strategies result directly or indirectly from interactions between IDPs and governmental and non-governmental organizations involved in the "post"-conflict governance environment.
3. Comparison of the social networks and livelihood strategies of the general population and IDPs.
4. Centering the forced migrant or IDP in the analysis of the "post"-conflict governance environment.

Thematic Areas

1. Forced migration (Internally Displaced Persons)
2. Governmentality in "post"-conflict communities (Caucasus, Georgia, Post-Soviet Societies)
3. Social networks, Gender, and Livelihood strategies

Methodologies

Semi-structured interviews, narrative interviews, and formal social network analysis

Recent Research Findings

Nearly 250,000 people became internally displaced due to separatist conflicts in South Ossetia and Abkhazia in the early 1990s. The conventional wisdom espouses that IDPs living in collective centers are worse off than those in private housing. This collective center/private accommodation dichotomy obscures more than it reveals. Our data show that IDPs living in private dwellings have similar difficulties in integrating as those IDPs residing in collective centers and may even have more difficulties in accessing certain types of resources. Thus we must take a more nuanced approach to these two previously taken for granted categories. There are a variety of factors to consider in order to gauge the context properly, including physical location (center of city vs. remote outskirts), condition of the dwelling, infrastructure (available water, sanitation, electricity, etc.), value of property (whether privatization of the collective center is a viable option), security of tenure (while it is understood that those in collective centers may be evicted, the same possibility applies to those in private accommodation as well), access to employment, and what type of social networks and means of community support are present.

IDPs in collective centers may be better off, for a number of reasons, than those in private housing. However, many IDPs in private accommodation have superior living conditions and opportunities than those living in collective centers. To frame the analysis of Georgian IDPs or the implementation of programs designed to help IDPs by using these two rigid categories is doomed to be very limited in achieving its goals. The majority of IDPs in fact live in private

accommodation, not collective centers, yet their needs are consistently overlooked. This is reproduced in data collection, humanitarian aid, and Georgian government assistance as well, since IDPs in collective centers are much easier to locate, talk to, and inform about various projects that assist IDPs. Due to this invisibility and the prominence of collective centers in the public imagination, IDPs in private dwellings have far fewer opportunities to encounter an NGO or government worker or partake in an assistance program.

Furthermore, our social network data show that, much more than dwelling type, income generation opportunities are a key element for better integration of IDPs into their local communities. Our findings suggest that those people (both IDPs and general population) with less dense social networks have a greater likelihood of being engaged in income generating activity. Also in our sample, more men are engaged in income generation activity and therefore may have more access to information that ultimately can lead to greater economic advantage. On the other hand, the number of NGOs and programs dedicated to and supportive of women is quite high, helping to provide aid, training, information, and resources, which slowly helps to counter the profound gender imbalances in Georgian society.

In contrast to men, women have clearly been the more active and productive beneficiaries of NGO and INGO activity. Many programs struggle to find enough male participants to achieve the desired gender balance, while turning away women. NGOs and INGOs need to focus on ways to be inclusive towards men so that more men can benefit from the loans, trainings, and workshops that have useful to many female IDPs. This may then help to stem the factors that instigate and increase domestic violence.

We are analyzing the quantitative and qualitative data from the 180 IDP and general population interviews conducted in 2007, as well as finishing up the analysis of interviews with 34 NGO representatives and government officials. We plan to finish conducting interviews with NGO representatives and government officials in October 2008, and conduct follow up interviews with IDPs.

Challenges and Opportunities

The political and economic situation in Georgia is volatile. Whereas previously one could debate about whether the description of the circumstances as “post-conflict” was accurate, with the recent failed attempt to retake South Ossetia by the Georgian military and Russian incursion into and occupation of Georgia, the climate is clearly one of “hot” conflict. The shifting political and donor landscapes provide both challenges and opportunities. For example, our survey has the opportunity to contribute to on-going and emergent political debates about forced migrant resettlement and integration; yet, the challenge is to get our results into the appropriate arenas in a timely fashion. Through highlighting of critical elements in the narratives and social network analysis we can extract from the perspective of IDPs the most important elements to keep them intact and which policies and agencies are most helpful and harmful to livelihood and human security. This dissemination will begin with a conference to be held on October 3, 2008 at Columbia University.

An important opportunity though is to use our methodologies that worked well conduct more interviews with IDPs from the recent Russian-Georgian conflict for comparative purposes, as well as to establish a baseline for important findings that include changing and divergent gender roles, temporal stability of social networks as well as the closed nature of those social networks, and IDP focus on past and future time periods rather than the present. Again, while we have an unprecedented opportunity to capitalize upon our methodology and contacts on the ground there, we have a challenge of obtaining appropriate funding for the additional work and the challenge of the continuation of armed conflict.

Project Title: Extensible Machine Intelligence for Automated Video Understanding of Longitudinal Change in Individual and Social Behavior

Proposal Number: 0624236

HSD Emphasis Area: Dynamics of Human Behavior

Lead PI: Howard Wactlar, Carnegie Mellon University
Co-PIs: Michael Christel, CMH; Alexander Hauptmann, CMU; Scott Stevens, CMU; Bryan MacWhinney, CMU
Collaborators: Frank Moretti, Columbia University Teachers College; Ashok Bhuracha, University of Pittsburgh, School of Medicine

Project Goals:

- Create tools and establish methodologies that will enable continuous, longitudinal observation and monitoring for behavioral research.
- Performance of integrated tools (accuracy, speed) shall surpass that of established manual and computer-assisted rating instruments based on human observation.
- Implement behavioral observation tools that are researcher extensible to account for needs that might arise from a particular study, environment, or discipline.

Thematic Areas:

- The elderly: nursing home patient social interactions and aberrant behaviors.
- The young: childhood and classroom communicative discourse
- The impaired: autistic behavior in the very young for training, diagnosis and treatment

Methodologies:

- Computer vision, speech understanding, machine learning and measurement technologies (e.g., environmental and biometric sensors) for a continuously captured audiovisual record of activity and behavior
- Information retrieval, reduction, and visualization through web-based digital video and data library
- Automated data anonymization, privacy, and security controls for data sharing
- Collaboration and access through a distributed digital “library” infrastructure
- Data export, exchange, and compatibility managed through adherence to standards

Recent Research Findings:

- An automatic algorithm capable of recognizing aggressive behaviors from video records using local binary motion descriptors.
- A system to monitor Visual Focus of Attention (VFOA) based on head poses.
- A novel framework of object categorization which takes advantage of hierarchical category information and performs object categorization at different levels.
- Three new algorithms for modeling background directly from compressed video, and a two-stage segmentation approach based on these background models.

Challenges and Opportunities:

- Move environments for investigation to those outside the subjects’ residence to the community for more robust social behavior observation: daily living event venues (retail stores, community centers) and outdoors (public areas, shopping malls, public transportation)

Project Title: Long-Term Dynamics of Population Growth, Agricultural Intensification, and Sociopolitical Change: Hawai‘i as a Model System

Proposal #: 0624238

HSD Emphasis Area: Dynamics of Human Behavior

Lead PI: Patrick V. Kirch, University of California, Berkeley
Co-PIs: Shripad Tuljapurkar, Stanford University
Peter Vitousek, Stanford University
Oliver Chadwick, University of California, Santa Barbara
Thegn Ladefoged, University of Auckland

International partners (if any): University of Auckland

Project Goals: Four goals were explicitly set out in our research proposal:

1. To extend our integrated analyses of Hawaiian dryland agricultural systems to the irrigated wetland agricultural systems that dominated the economies of windward landscapes of the older Hawaiian Islands.
2. To analyze the dynamics of an agricultural population coupled to a nutrient-cycling model of agriculture. We will study *resource-limited growth*, in which populations expand into a previously unoccupied area, and *space-limitation*, which is characterized by agricultural intensification and expansion into marginal habitats.
3. To investigate temporal changes at the household (microscale) level of social organization and in the domestic economy and production of surplus, and to determine how changes at the household level were linked to the emergence of a regional-scale integrative political economy. This aim can be approached through intensive study of archaeological household sites.
4. To evaluate the consequences of different forms of social organization for population growth, stability, and well-being, and for resource surplus, shortage, and sharing. We will formulate and analyze models of complex hierarchical societies, both in terms of patterns of resource transfers and control, and in terms of competition between populations in different habitats.

Methodologies: Our project combines archaeological investigation of prehistoric household units, with GIS modeling of spatial and temporal variability in agricultural landscapes, and with theoretical modeling and simulation of long-term population dynamics.

Recent Research Findings: Our recent research findings are summarized here in terms of three areas of emphasis: (1) archaeological investigations; (2) geo-spatial modeling of agricultural landscapes; and (3) modeling of population dynamics.

1. Archaeological Investigations. The field component of our project has focused primarily on the leeward area of Kohala district on Hawai'i Island, where we have been surveying and excavating a sample of prehistoric household sites, in order to obtain empirical data on household size and composition, the temporal development of households over time, the differential access to marine resources by households of different status levels, and the degree of surplus extraction as represented by the faunal remains of domesticated animals. The location of our study area is shown in the following figure.

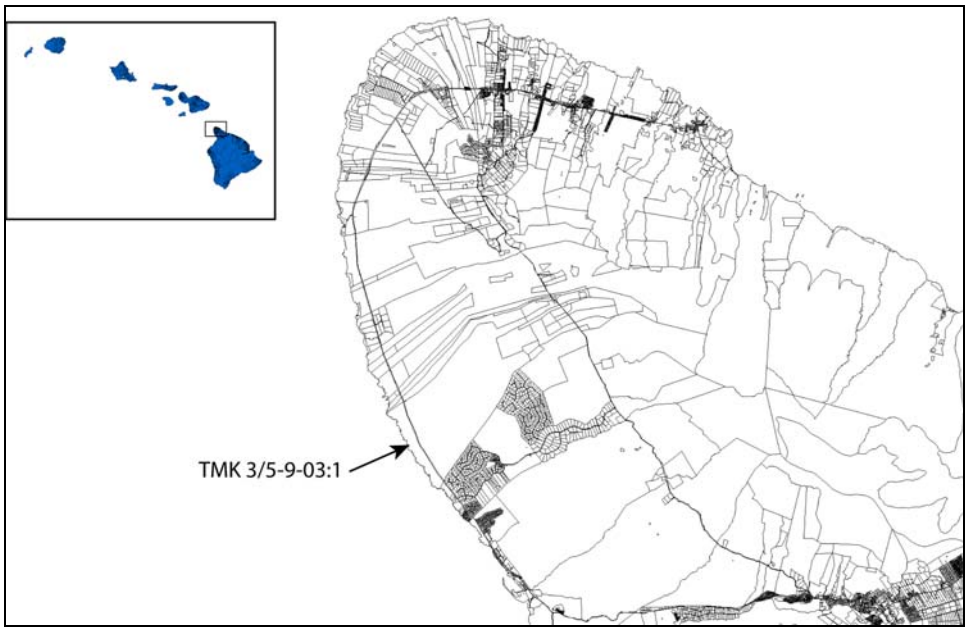

Figure 1. Location of study area TMK 3/5-9-03:1, on the coast of leeward Kohala, on the Island of Hawai'i.

In 2007 a total of 11 household sites along the coast of Makiloa-Kalala were sampled by archaeological excavation. These represent both commoner and elite residences, thus providing important data on differences between households in a stratified society. In 2008 we extended our survey and excavations to a set of inland households in the Kaiholena-Make'anehu region. A precise chronology for the development of these households is beginning to emerge from radiocarbon dating of features within these sites. Analysis of faunal materials, including both marine resources and domestic animals, is proceeding. We will complete a third set of excavations in 2009.

2. Geo-Spatial Modeling. Another major thrust of our work in Year 2 of this project consisted of developing a Geographic Information Systems (GIS) model of the two major kinds of contrastive agro-ecosystems that were distributed across the Hawaiian archipelago: (1) irrigated taro agricultural systems; and (2) intensified dryland field

systems. Intensive agricultural systems interact strongly and reciprocally with features of the lands they occupy, and with features of the societies that they support. We modeled the distribution of two forms of precontact intensive agriculture – irrigated pondfields and rainfed dryland systems—across the Hawaiian archipelago using a GIS approach based on climate, hydrology, topography, substrate age, and soil fertility. Predicted distributions of irrigated and rainfed systems generally matched the corresponding distributions documented via ethnographic, ethnohistorical, or archaeological surveys – with exceptions that allow us to evaluate how completely indigenous Hawaiians had reached the productive potential of the land. We calculate that the youngest island, Hawai‘i, could have supported 600 km^2 of intensive agriculture, 93% as dryland field systems, while Kaua‘i, the oldest island, could have supported 145 km^2, all as irrigated wetland systems. Irrigated systems have higher, more reliable yields and lower labor requirements than rain-fed dryland systems – so the total potential yield from Kaua‘i (~106k metric tons) was more than half that of Hawai‘i (~197k metric tons), although Kaua’i systems required a much smaller agricultural labor force (~21,000, versus ~169,000 on Hawai‘i). We conclude environmental constraints to intensive agriculture across the archipelago created asymmetric production efficiencies, and therefore varying potentials for agricultural surplus, which likely had substantial sociopolitical and environmental implications for Hawaiian ecosystems and society. These results have been written up and submitted for publication as an article for the journal *Ecosystems*.

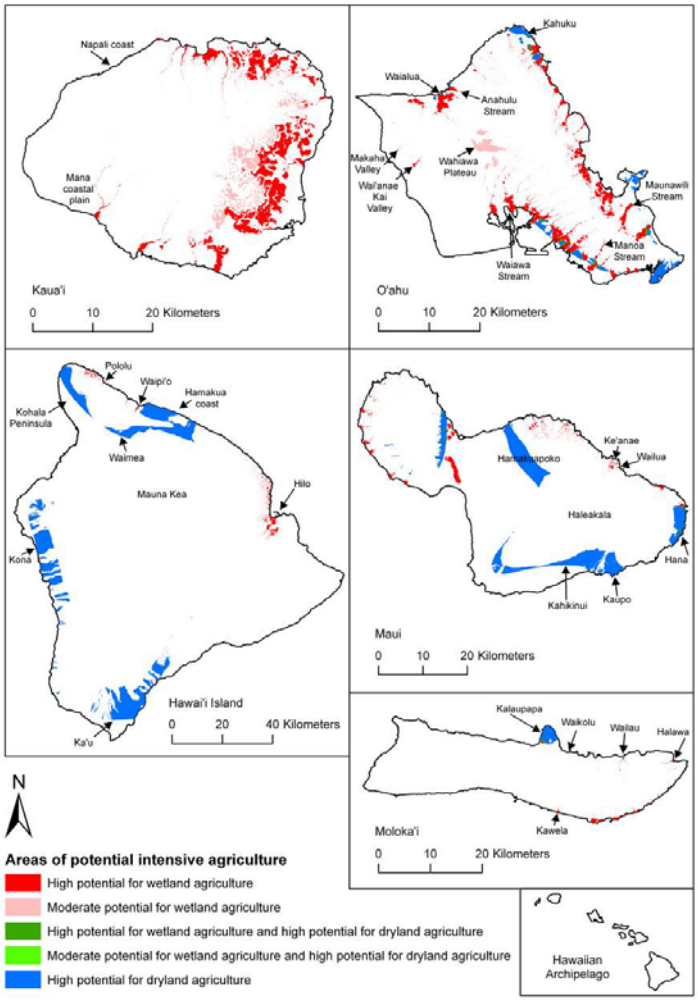

Figure 2. Geo-spatial modeling of areas of potential intensive agriculture across the major islands of the Hawaiian archipelago (from Ladefoged et al., submitted, *Ecosystems*).

3. Modeling Population Dynamics. We have made considerable progress on theoretical models of human-agriculture-food dynamics with two papers published on a general modeling approach and its applications, and paper published on the effects of spatial and temporal variability in food production across the landscape.

The first paper develops a demographic model that describes the feedbacks between food supply, human mortality and fertility rates, and labor availability in expanding populations, where arable land area is not limiting. This model provides a quantitative framework to describe how environment, technology, and culture interact to influence the fates of preindustrial agricultural populations. We derived equilibrium conditions and derive approximations for the equilibrium population growth rate, food availability, and other food-dependent measures of population well-being. We examined how the approximations respond to environmental changes and to human choices, and find that the impact of environmental quality depends upon whether it manifests through agricultural yield or maximum (food-independent) survival rates. Human choices can

complement or offset environmental effects: greater labor investments increase both population growth and well-being, and therefore can counteract lower agricultural yield, while fertility control decreases the growth rate but can increase or decrease well-being. Finally we established equilibrium stability criteria, and argue that the potential for loss of local stability at low population growth rates could have important consequences for populations that suffer significant environmental or demographic shocks.

The second paper examines the forces that determined the quality and quantity of human life in early agricultural societies where cultivable area is limited. The model is driven by the non-linear and interdependent relationships between the age distribution of a population, its behavior and technology, and the nature of its environment. The common currency in the model is the production of food, on which age-specific rates of birth and death depend. There is a single non-trivial equilibrium population at which productivity balances caloric needs. One of the most powerful controls on equilibrium hunger level is fertility control. Gains against hunger are accompanied by decreases in population size. Increasing worker productivity does increase equilibrium population size but does not improve welfare at equilibrium. As a case study we apply the model to the population of a Polynesian valley before European contact.

The last paper used our theoretical approach to shed interesting light on prehistoric and protohistoric territorial configurations in the leeward Kohala dryland field system. We modeled agricultural surplus production and life expectancy to identify the costs and benefits associated with dynamic territorial units. The results of the modeling indicate that if people lived autonomous lives within their territories the 18-km long landscape containing the field system would have been optimally divided into 14 territories. The archaeological and ethnohistorical data suggest that at European contact the area was divided into 32 generally smaller territorial units. This configuration, while lowering average life expectancy and increasing levels of spatial variability in surplus production, maximized average yearly surplus and reduced its temporal variability.

Lee, Charlotte T., Shripad Tuljapurkar. 2008. Population and prehistory I: Food-dependent population growth in constant environments. Theoretical Population Biology 73: 473-482.

Puleston, Cedric, Shripad Tuljapurkar. 2008. Population and prehistory II: Space-limited human populations in constant environments. Theoretical Population Biology 74:147-160.

Ladefoged, Thegn N., Charlotte T. Lee, Michael W. Graves. 2008. Modeling life expectancy and surplus production of dynamic pre-contact territories in leeward Kohala, Hawai‘i. Journal of Anthropological Archaeology 27: 93110

Challenges and Opportunities: The major challenge—and opportunity—facing our team in the coming year is the integration of our theoretical models which are now fairly well advanced, with the empirical data on long-term population dynamics and agricultural intensification which are being extracted from archaeological contexts. We believe that

the testing of theoretical models with empirical data from the archaeological record will be one of the strengths of this project.

Project Title: Decentralization and Local Public Goods: How does allocation of decision-making authority affect provision?

Proposal Number: 0624256

HSD Emphasis Area: Dynamics of Human Behavior

Lead PI: Malgosia Madajewicz, IRI, Columbia University
Co-PIs: Regina Dolgoarshinnykh, Ji Meng Loh and Alexander Pfaff
International Partners: NGO Forum for Drinking Water and Sanitation, Bangladesh

Project Goals:

1) (**DHB**) Theory: Determine what allocation of decision-making authority maximizes social welfare in a problem of providing a local public good. We will:
    (i) Compare outcomes when a central organization, such as a NGO, government or private firm, makes all decisions and when the community which will be using the public good makes all decisions in a dynamic model of interaction between individual agents. Outcomes will include social welfare, access to the public good, costs of access. We will examine central organizations with different objective functions.
    (ii) Determine what allocation of decision-making authority maximizes social welfare.
    (iii) Determine how the welfare-maximizing allocation of decision-making authority and outcomes in the two cases in (i) depend on individual and average attributes of social networks, individual and average community wealth, wealth inequality, and size of community.
2) (**DHB, AOC**) Empirical: Collect original data generated by an organizational experiment to test and revise the theory and distill policy implications. In the empirical context, the organizational change which we will observe will be due to a natural disaster; the natural occurrence of high concentrations of arsenic in groundwater in Bangladesh. We will:
    (i) Conduct an organizational experiment in which we choose randomly which village receives one of three types of interventions to provide access to safe water and which is in a control group in which no intervention occurs. The interventions will correspond to organizational forms we study in the theoretical model.
    (ii) Determine which intervention yields the best average outcome. Determine for which types of communities each intervention is best by examining how the outcomes of each intervention vary with characteristics of social networks, distribution of wealth, and size of village.
    (iii) Use the control group to study communities in which collective action occurs in the absence of any intervention, i.e. determine the attributes of communities which solve the public good provision problem on their own.

Thematic Areas:

1. Dynamics of human behavior
2. Agents of change

Methodologies:

1. Dynamic models of interaction between individual agents whose behavior has stochastic elements and who are placed on a graph which models social networks. Solution methods include analytical methods as well as simulation.
2. Randomized field trial
3. Household surveys which collect new data.
4. Econometric analysis of data.

Recent Research Findings:

1) We have developed a model to understand how many people in a community decide to contribute to the provision of a public good, in our case a source of safe drinking water. The model is somewhat unique in that we can explicitly solve for the contributions which people

choose to make in a model with dynamic decision making in which people maximize expected utility. We have shown existence of equilibria with analytical methods.

We are observing some interesting tendencies in analyses based on simulations. Contributions to the public good converge to zero as the number of people participating in the contribution game increases, as traditional economic theory would suggest. However, the size of the group at which contributions begin to converge to zero is very large, which is not what one would expect based on the existing literature. This result finds potential support in recent experimental literature, which reports much more widespread propensity to contribute to a public good in experiments than existing theoretical analyses suggest. Also, in our model the size of the group at which contributions begin to converge to zero depends on the average wealth in the group and on the distribution of wealth. This relationship has not received much attention in the existing literature.

We are examining the properties of the model using both simulations and analytical techniques. We are particularly interested in the effects which the average wealth in the group and the distribution of wealth have on contributions, and in the way in which these variables interact with group size. There are contradictory results regarding the effect of average wealth and distribution of wealth on contributions to a public good in the existing economics literature. We hope to reconcile the results by categorizing the conditions which determine the direction of the effect exerted by wealth.

In the next stage, we will analyze the effect of several characteristics of social networks on contributions to the public good. We will then examine how the results change when an organization external to the group of potential users of the public good, such as a government or private development organization, is able to enforce some rules for the contribution process.

2) We have completed a baseline survey of 10,000 households in 250 villages in Bangladesh. We are currently implementing a field trial in those villages, in which we have randomly assigned three different models of organizing the provision of safe drinking water to the villages. A randomly chosen subsample of villages serves as the control group, in which no intervention occurs to help provide safe drinking water.

   The three models differ in how the village community participates in the provision process. One model is based on the traditional approach taken by development projects, which is still most common, in which a development agency makes all decisions. In our model, there is more community participation than is common, because we ask for community contributions to the source of water. Only communities which agree to make these contributions receive a source of safe water. However, all decisions about the source of safe water and the manner of its provision are made by the development agency, a large Bangladeshi non-profit which specializes in sanitation and drinking water.

   In the second model, the community makes all decisions regarding the choice of the source of safe drinking water and the manner of its implementation. The non-profit agency provides technical information and part of the funding.

   In the third model, the non-profit agency sets rules for the community participation. The community makes all decisions, but only those decisions can be implemented which have been reached unanimously in a meeting which satisfies a number of participation criteria. The non-profit agency provides technical information and part of the funding, and the information which it provides and the funding contribution are the same across the three models.

   We will conduct a follow-up survey in the intervention and the control villages to document the impact of the three different models after we finish providing safe drinking water in all intervention villages. The strength of the approach is that we will be able to interpret any

differences in outcomes between villages as differences in the effects of the models. Since the model allocation was random, the choice of organizational form is not correlated with community characteristics which could also affect outcomes.

We have preliminary, anecdotal evidence that the three different approaches are producing rather different outcomes. We have been audio taping some of the meetings between the non-profit's staff and the communities and we hope to write up the initial observations over the next several months.

Challenges and Opportunities:

1) Modeling a complex behavioral problem in a tractable but non-trivial way.
2) Combining research and effective assistance to communities in need. It has been both a challenge and an opportunity to implement three different organizational models in the field and maintain an experiment valuable from a research perspective, while ensuring that the interventions address the problem of safe drinking water as effectively as possible and that the villagers do not perceive the assistance as an academic experiment which puts research before their needs.
3) Designing the theoretical work and field work in such a way that the evidence can be used to directly test the theoretical results without compromising focus on the significant and difficult questions.

Project Title: Improvisation in Emergency Response: Linking Cognition, Behavior and Social Interaction

Proposal Number: 0624257

HSD Emphasis Area: Agents of Change

Lead PI: David Mendonça, New Jersey Institute of Technology
Co-PIs: Carter Butts, Univ. of California at Irvine; Gary Webb, Oklahoma State University

Project Goals:
Large-scale disasters—whether induced by human, technological or natural causes—require society to plan for and respond to substantial disruption. As agents of sometimes profound change, disasters require integrated planning and response at multiple levels, but they also demand flexibility and an ability to improvise. This project is the first large-scale study to investigate improvisation at the nexus of cognitive, behavioral and social interaction phenomena in disaster response.

The three main goals of this work are

1. to explain the dynamics of improvisation in response to the 1995 Oklahoma City bombing and the 2001 World Trade Center attack;
2. to represent and make publicly available machine-readable data and tools from the project; and
3. to develop and evaluate materials to support training and policy making regarding improvised response to disaster.

Thematic Areas:

- *Human behavior in disaster response*: exploration of the cognitive, behavioral and interaction processes at individual through organizational levels.
- *Multi-method analysis*: integrated quantitative and qualitative approaches to the analysis of multi-level data.
- *Data-driven policy*: implications for policy and procedures regarding response activities.

Methodologies:

- We seek to understand the dynamics of improvisation by conducting qualitative and quantitative (statistical) analysis of data from communication and dispatch logs, as well as from interviews with response personnel.

- We seek to create, document and disseminate data sets—consisting of digitized copies of original materials, and data associated with their analysis—as well as measurement tools and methods for data analysis.

Recent Research Findings:
1 Integrating Cognitive and Behavioral Perspectives
The literature on improvisation in various disciplines has argued forcefully and convincingly that improvisation is more than a guessing game. Rather, improvisation is expected to involve a combination of executive-level control that is highly responsive to changing conditions, along with an ability to mix and match pre-compiled routines.

From the perspective of **cognition**, response personnel must identify response *goals*, *observe* conditions in the field, formulate explanations (i.e., *hypothesize*) to explain them, and act (i.e., *experiment*) to influence them.

From the perspective of **behavior**, response personnel's action may be characterized by examining four dimension of each action: *status* (i.e., the position occupied by the person);

procedure (i.e., the way in which a role is performed), *equipment* (i.e., the tools used in performing the role), and *location* (i.e., the physical place where the role is performed).

Understanding hypothesizing in relation to behavioral improvisation is a first step in identifying links that relate expectations about the consequences of decisions to choices about how to perform roles. Decision makers are expected to seek to explain the situation they face as well as to attempt to determine how to address it, particularly in situations that engender improvisation, thus leading to proposition CB:

> **CB:** A positive correlation is expected between number of hypothesis statements and number of improvised behavioral events for a given respondent, an effect that is expected to be amplified with event magnitude.

2 Method

A sample of thirty official police reports was randomly selected for each of the two events, the 1995 Oklahoma City bombing (OKC) and the 2001 World Trade Center attack (WTC). These materials were then converted to machine-readable documents, which were then provided to human coders along with instructions for identifying the cognitive and behavioral events described previously. Proposition CB is addressed via statistical hypothesis testing, as described below.

3 Results

Results for each respondent were first tabulated, yielding counts of reported cognitive and behavioral events. The mean number of hypothesis-type cognitive events per respondent for OKC is 3.0 (std. dev.=5.2) and for WTC is 2.3 (std. dev.=4.0). As a second example, on average, the respective mean number of improvised procedural, status, equipment and location behavioral dimensions is 3.0, 0.2, 1.1 and 0.4 for OKC, and 3.4, 0.5, 0.7 and 1.1 for WTC (respective std. devs for OKC were 3.3, 0.6, 1.8 and 0.6, and for WTC were 3.9, 1.1, 1.3 and 1.3).

Consistent with **CB**, the Pearson product-moment correlation between number of hypothesis-type cognitive events and number of improvised behavioral events was positive for both OKC (r=55.5%, p=0.0015) and WTC (r=67.9%, p<0.0001). The extent of hypothesizing correlates positively with the extent of improvising to a significant degree regardless of event size. Of course, it must be kept in mind that improvised behavioral events make up only a small percentage of all behavioral events. Yet within this set of improvised behavioral events it appears that improvisation is not a guessing game (else the correlations would have been negative).

4 Summary

The results of this work provide a degree of continuity and complementarity with prior research on organized response to disaster. Yet they also suggest how understanding of social order among established organizations can be enriched through examination of the cognitive processes of individual response personnel. Both stability and change with respect to role performance characterize the response to both events, but among these established organizations it may be seen that conventional behavior dominates—despite the highly non-routine nature of both events. The observed significant positive relationship between the degrees of hypothesizing and improvising suggests a possibly fruitful line of research into how established organizations develop, enact and possibly learn from improvised decisions.

Challenges and Opportunities:

Other ongoing work in this project includes dynamic event modeling, the relationship between role behavior, cognition, and interaction, and the association of these phenomena with position. This work has led to a forthcoming article by Butts in *Sociological Methodology*. In year 3, the integrative modeling of cognition, behavior, and interaction will constitute an increasingly central focus of our work.

Project Title: Exploring the Social Dynamics of Accessibility, Travel Behavior, and Physical Activity by Income/Race, Age and Gender: An Inner-City/Suburb Comparison in the Detroit Region

Proposal Number: 0624263

HSD Emphasis Area: Agent of Change

Lead PI: Igor Vojnovic (Michigan State University).
Co-PIs: Joseph Messina (Michigan State University), June Thomas (Michigan State University), Kameshwari Pothukuchi (Wayne State University), Ellen Velie (Michigan State University).
Collaborators: Joe Darden (Michigan State University), Bruce Pigozzi (Michigan State University), Daniel Griffith (University of Texas at Dallas).

Research Goals:
1. To measure neighborhood accessibility and quantify functional differences for two two-miles squared inner-city Detroit sites, and four suburban sites in each of the cities of Bloomfield, West Bloomfield, Birmingham, and Ann Arbor selected, based on socioeconomic status and race/ethnicity.
2. To explore how perceptions of travel behavior—and specifically motorized versus non-motorized travel—vary by income, race, age, gender, and neighborhood structure.
3. To explore urban structural modifiers of behavior including system feedbacks, thresholds, and dynamics in a complex systems simulation framework.

Thematic Areas:
1. Spatial Analysis and Complex System Simulations
2. Urban and Transportation Geography
3. Urban Planning and Design
4. Public Health

Methodologies:
The team will gather data from six two-mile square neighborhoods in the Detroit Region. Surveys will be mailed to 1600 households in the two Detroit neighborhoods and 800 households in the four suburban sites. This will enable the research team to focus on urban form, travel behavior, physical activity, and obesity within the context of diverse socioeconomic conditions and race/ethnic populations. Statistical methods of relevance include dummy variable regression, polynomial regression, network structures, location-allocation models, and discriminant analysis. Multinomial logit models will be used to explore the relationship between the built environment, physical activity and obesity. A dynamic spatial simulation-modeling environment will be employed to characterize, link, and model structural determinants, feedback systems, thresholds, and individual, household, and community behaviors. The project intends to integrate modern computing and simulation theory with urban design, two research tracts have been dissimilar enough in both language and methods to inhibit collaborative work.

Recent Research Findings:
The project is still in its data collecting and coding stage. One dimension of the work over the last 20 months has concentrated on the land use analysis, the GIS mapping, and the 3D AutoCAD modeling, which is all completed. A second component of the project is the survey collection and coding. The team has collected about 1200 surveys so far and we are continuing to go door-to-door in our Detroit area neighborhoods in an attempt to increase project participation. As the surveys continue to be collected, we are also proceeding with the data clean-up and coding.

Challenges and Opportunities:
We are currently exploring modeling environments to include both the proposed expansion of the CAPE model developed by Messina as part of NASA NAG 5-12617 and also the NetLogo modeling environment. Both modeling tools allow for the inclusion of multiple land cover types or multiple agents. At this early stage in the research we are allowing the emergent research questions to dictate modeling environments rather than enforcing an inappropriately constraining

system on the neighborhoods and Detroit context. Further, we are not pre-ordaining our complex modeling environment as it is yet to be determined which if not more than one theoretical complex interactive systems are active. To date the vast majority of the geospatial modeling work has focused on database development.

One issue that we faced in running the survey was the rapid increase in vacancies that became evident with the growing housing and mortgage crises across the US. We purchased our neighborhood addresses from the relevant postal departments across the Michigan region. From the point that we purchased the addresses, which included only occupied residences, to the point that we selected our random sample, sent out the project introduction prompt, the survey package, and the two reminder prompts, some 12% of the randomly selected dwellings had been vacated. In total, this covered only a three month period. The canvassers have recognized an even greater number of vacancies as they have been going door-to-door throughout the neighborhoods.

Related to the survey, in this past project year we hired our two city of Detroit community canvassers. Our original idea was to hire two women (because of the disproportionate economic hardship of single mothers in the city of Detroit), but because of safety issues in the neighborhoods, we agreed to have two canvassers together at all times, and that one should be a man. Both canvassers, Olga Smith and Stanley Smith, were hires from one of our Detroit neighborhoods. As it was set out in one of our goals, under broader impacts in the original proposal, we worked closely with the two faith-based organizations in selecting the two hires. Olga Smith and Stanley Smith were unemployed, but have had a long history of volunteer work with one of our faith based partners, U-SNAP-BAC. They are also very familiar with the Detroit neighborhoods that are part of our project and are well known in the community because of their prior volunteer work with U-SNAP-BAC.

We organized a training session for Olga and Stanley Smith at Michigan State University. During the session, the research team had a chance to get to know Olga and Stanley, and they also got to know us. They were introduced to the project and research objectives. We also had a long and detailed discussion of the survey questions, as well as their tasks in canvassing the neighborhoods. Olga and Stanley are still working with us, going door-to-door in the Detroit neighborhoods to encourage a greater response rate. They have also been giving us considerable insight into the Detroit neighborhoods. In addition, the Detroit inner-city residents have been interacting and responding to them, since they are part of the community, much more openly than they have been to the other team members from MSU and WSU. Olga and Stanley have become an important part of the project team and an indispensable link between the project team and the Detroit inner-city communities.

Project Title: Victims' Responses to Transitional Justice: A Comparative Study in West Africa

Proposal Number: 0624278

HSD Emphasis Area: Agents of Change

PI: David Backer, Department of Government, College of William & Mary
Collaborators:
Associate Investigator: Anupma Kulkarni, School of Justice and Social Inquiry, Arizona State University
Advisors: Harvey Weinstein, Human Rights Center, University of California – Berkeley; Brandon Hamber, INCORE (Belfast, Northern Ireland); Hugo van der Merwe, Centre for the Study of Violence and Reconciliation (Cape Town, South Africa); Terry Karl, Stanford University
Country Partners: E. Gyimah-Boadi [Ghana], Ghana Center for Democratic Development (Accra, Ghana); Ezekiel Pajibo [Liberia], Center for Democratic Empowerment (Monrovia, Liberia); Sonny Onyegbula [Nigeria], UN High Commissioner for Human Rights (Moroto, Uganda); Paul James-Allen [Sierra Leone], International Center for Transitional Justice (Monrovia, Liberia)
Organizational Partners: Ghana Center for Democratic Development (Accra, Ghana), Center for Democratic Empowerment (Monrovia, Liberia), Sierra Leone Court Monitoring Program (Freetown, Sierra Leone)
Research Managers: Joseph Asunka [Ghana], Emmanuel Kailie [Liberia], Kayode Samson [Nigeria], Mohamed Suma [Sierra Leone]
Other Personnel: Approximately 100 moderators, translators, fieldworkers, facilitators and student research assistants.

Goals:
This project examines the consequences of the choices societies make about how to address past violations of human rights during the course of transitions from periods of violent conflict (e.g., state repression, war, genocide), which have been a prevalent phenomenon around the world over the last several decades. A key contribution is to assess the efficacy of these decisions about 'transitional justice' from the distinctive vantage point of the victims of abuses, whose perspective is underrepresented in related academic and policy discussions and rarely the subject of intensive primary empirical research. As a result, the latent question of whether or not they accept the measures that are implemented for the purposes of conflict resolution and democratization remains largely unanswered, though members of the project team and others have previously conducted relevant research in South Africa and elsewhere.
Our study extends that prior work and seeks to evaluate a wide range of common theoretical propositions and policy prescriptions by exploring the reciprocal relationships among (1) transitional justice processes, with particular attention paid to recent truth commissions—designed around the South African model—that emphasize participation by victims; (2) the attitudes and behaviors of victims that are central to their agency in the new dispensation; and (3) trajectories of political and social development. The research focuses on four post-conflict societies in West Africa: Ghana, Liberia, Nigeria and Sierra Leone. These cases afford a useful cross-section of historical legacies (military regimes, civil war, ethnic conflict) and transitional justice measures (prosecutions, truth commissions, reparations, institutional reform, amnesty) that are closely linked in practice. The resulting analysis will constitute the first multi-country study in this field to be based principally on primary data collected from victims of human rights violations. In addition, the Liberia component will involve unprecedented longitudinal analysis (to assess changes over time) and research in the diaspora (to gauge variation by context). The study design also permits novel insights concerning the interactions among local, national, regional and international forms of post-conflict accountability and democracy promotion.

Thematic Areas:
Political Science
Human Rights
Conflict Resolution

African Studies
Law
Sociology
Psychology
Public Health

Methodologies:
Our basic research framework focuses on collecting extensive primary data using multiple complementary techniques. The initial step is to conduct sets of focus groups with key segments of the victim population. (e.g., war wounded, amputees, women, child soldiers). These moderated discussions (tape recorded for later transcription and review) delve into the circumstances of past conflict and exposures to violence, options for transitional justice, and the nature of attitudes about local and national politics. The insights from the discussions (and official documents pertaining to transitional justice institutions) then inform the development of a survey questionnaire, comprised of a large core of items that is common to all four countries in order to facilitate cross-national comparisons, plus select items added and/or tailored to reflect individual country contexts. The next step (following training of fieldworkers, including a pilot test of the questionnaire) is to administer the survey to a broadly representative sample of victims. (The Liberia study differs in that small numbers of respondents were recruited from the general population as well as the diaspora, to provide further bases of intra-case comparison.) The responses are entered (from electronic files generated by scanning the completed questionnaires on site) to allow statistical and content analyses. The final step is to conduct open-ended interviews with a small sub-set of the survey respondents, to investigate issues in greater depth and (together with the material from the focus groups) provide explanations and illustrations that enrich the quantitative results. In addition, a second wave of data collection will be completed in Liberia—using a panel approach—after the truth commission has concluded its activities, projected for mid-2009.

Recent Research Findings:
No results are available to summarize, since the process of converting the extensive survey data we collected between March 2007 and April 2008 (see below) were only recently completed, allowing us to commence statistical analysis in August 2008. We can, however, report significant progress:

1. *Focus Groups*: four 1-3 hour sessions, consisting of 6-15 participants apiece, conducted in Liberia, Nigeria and Sierra Leone (Ghana was omitted because collaborators had previously engaged in substantial research concerning the National Reconciliation Commission process).
2. *Questionnaire*: large roster of items developed, translated from English into 16 languages (Ghana: Akan, Dagbani, Ewe, Ga, Hausa; Liberia: Pidgin English, Bassa, Kpelle; Nigeria: Hausa, Igbo, Ogoni, Yoruba; Sierra Leone: Krio, Limba, Mende, Temne), back-translated to English as a verification check, and compiled into bilingual (English +) versions.
3. *Survey*
    - Liberia: 1072 respondents interviewed during March-April 2007 in six of the 15 counties.
    - Liberia Diaspora: 24 respondents interviewed in Ghana during May 2007; planning underway for a similar mini-survey in Sierra Leone.
    - Nigeria: 477 respondents interviewed during March-April 2008 in 12 of the 36 states plus the Federal Capital Territory of Abuja.
    - Sierra Leone: 500 respondents interviewed during April-May 2007in 10 sites across all four provinces.
    - Ghana: 506 respondents interviewed during May-June 2007 in nine of the 10 regions.
4. *Data Processing*: double entry, reconciliation and cleaning completed for all four surveys; coding of qualitative material, including focus group transcripts and open-ended survey questions, currently being arranged.

Challenges and Opportunities:

We have faced several major hurdles in organizing and implementing the project. One is the difficulty of undertaking large-scale fieldwork in multiple countries, where a crucial consideration is the coordination of the substantive research agendas (to permit rigorous and meaningful comparisons) and the schedules of project activities (to use time and resources as efficiently as possible, under constraints of availability, travel parameters, weather, political events, etc.). Finalizing the many translations and compiling contact lists of victims proved to be especially demanding tasks. Another is the complications presented by these particular countries, including poor infrastructure (electricity, technology, communications, roads, etc.), a lack of experience with survey research, and limited availability of necessary information. Access has been a modest (but surmountable) issue in some locations. Local cultural practices have also intervened, with the most notable instance being an incident where three fieldworkers thought they had been attacked by a devil. In addition, the relationships with certain of the country and organizational partners have not always been smooth, resulting in unanticipated delays, occasional distress and financial disputes.

Despite the problems that have arisen, we feel that we managed to accomplish a substantial amount in a relatively short period, even expanding the volume (increasing the number of respondents) and scope (adding the Liberia diaspora component) of data collection well beyond what we envisioned at the proposal stage, which we expect will enhance the utility of the final products. In the process, we have devised research protocols and instruments, as well as formulated operational strategies, that can be applied in other settings. We have also capitalized upon this project to develop close(r) relationships with many of the collaborators and to invest in meaningful capacity building at an individual, organizational and inter-organizational level that we believe will have long-term value. Interactions among this network and in the course of the fieldwork have highlighted the prospects for broader impacts in areas such as policy design and evaluation, research methodology and ethics, and pedadogy.

Project Title: How Institutions Think About the Unthinkable

Proposal Number: 0624296

HSD Emphasis Area: Dynamics of Human Behavior

Lead PI: Karlene Roberts and Daniel Farber, University of California, Berkeley
Co-PIs: Michael Hanemann, James Hunt and Raymond Seed, University of California, Berkeley

Project Goals:

- To understand how knowledge generated from catastrophes is created and transferred
- Demonstrate how knowledge is transferred through inter organizational networks
- Show how organizations incorporate knowledge into their own practices

Thematic Areas:

- All 5 studies in this research take a relational view
- All hinge on different disciplines but attempt discipline integration
- All focus on the theme of knowledge generation
- There is considerable team focus on learning the skills of interdisciplinary research

Methodologies:

- Archival
- Use of existing data bases
- Surveys
- Observation
- Experiments

Recent Research Findings:

Publications

Farber, D.S., Bea, R.G., Roberts, K.H., Wenk, E., and Inkabi, K. (2007) "Reinventing Flood control" Tulane Law Review, 81 , 1085-1127.

Van Stralen, D.W., Calderon, R.C., Lewis, J.F., and Roberts, K.H. (2008) "Changing a Pediatric Sub Acute Facility to Increase Safety and Reliability." In J.D. Blair, M.T. Fottler and G.T. Savage (Eds.) Patient Safety in Health Care Management: Advances in Health Care Management, West Yorkshire, England: Emerald 7, 251-274

Roberts, K.H., Desai, V., and Yu, Kuo (2008) "Decision Making in High Reliability Organizations." In Starbuck, W., and Hodgkinson, G (Eds.) Oxford Handbook of Organizational Decision Making, London: Oxford., 194-210.

Bea, R.G., Farber, D., Foster, H., Mitroff, I., and Roberts, K.H. (in press) "A New Approach to Risk: The Implications of E3." Risk Management.

As yet unpublished research

One of the projects supported by this grant concerns information processing distortion by decision makers, and is headed by Dan Farber (School of Law, University of California). The working hypothesis is that, just as there is an endowment effect by which people place a higher value on objects that they own, there is a similar information endowment effect by which people overvalue information to which they have privileged access. There is considerable anecdotal support for this in accounts of crisis decision making, particularly regarding the use of classified information in the national security context. However, there is little in the way of rigorous analytical investigation. We are in the process of designing experimental setups for use in the X-Lab at the Haas School of Business, University of California, Berkeley in order to test this. We currently are investigating possible use of an auction with assymetrical information along with another survey-based approach.

The investigation of how risk analysis is used in environmental assessments continues. Dan Farber is currently writing a paper on this subject for a symposium on risks and new technologies in Issues in Legal Scholarship. He has a considerable amount of information about how this issue is handled under NEPA. The judicial decisions on the subject come primarily from water projects and nuclear liscensing. In terms of the later topic, Dan has completed work on how the treatment of nuclear releases from individual power plants is handled in impact statements, and he is now investigating the issues of releases from nuclear waste disposal. The most interesting question turns out to be the treatment of model uncertainty in impact statements. Dan will hire a graduate student from the Energy and Resources Group to assist in dealing with the technical and social science aspects of these issues.

Another area of investigation that has opened up relates to risk management via the tort system. In terms of flood risk, there is a particularly interesting contrast between the way California and federal law handle risks from defective flood control systems. Dan explores this issue in a forthcoming paper.

Anne O'Connell, also in the School of Law, is working on two projects. One is concerned with the Qualifications of Agency Leaders using a database that I am finishing constructing a database of top agency leaders from President Carter to President George W. Bush. The database contains a wealth of information on nearly 1,000 individuals who have served in a Senate-confirmed agency position (education, pre-employment, post-employment, campaign contributions, demographic characteristics, etc.) under Presidents Carter through George W. Bush. The other is concerned with Congressional Oversight of the Intelligence Community. A book chapter discussing this project is listed under publications.

As another part of this project PhD student Mary Kate Stimmler (Haas School of Business) is examining why some organizations fall into competency traps, in which they continually refine the same capabilities rather acquire new ones. The result, in the words of Cohen and March (1972), is that "solutions are looking for problems," rather than the reverse. Competency traps are especially dangerous in disaster response situations, where each situation is unique and the range of potential problems is great. Therefore, understanding the origins of maladaptive specialization is critical to the performance of disaster response teams

Challenges and Opportunities:
Because of this research our Collaborative for Catastrophic Risk Management (CCRM) has been approached by EADS, North American, for possible inclusion in their new United States based Innovation Works. EADS supports 20 research centers around the world each to the tune of approximately USD twenty million annually. They identified CCRM as potentially a source of rich cross disciplinary research. We consider this an opportunity.

Our greatest challenge is to nurture the group's own learning of how to do cross disciplinary work.

Project Title: Collaborative Research: AOC Social Complexity and the Management of the Commons

Proposal Number: 0624297

HSD Emphasis Area: Agents of Change and Decision Making, Risk, and Uncertainty

Lead PI: David Bennett, The University of Iowa
Co-PIs: Catherine Kling, Iowa State University; David McGinnis, Montana State University-Billings; Paul Robbins, The University of Arizona

Project Goals:
In this grant we seek to understand:

- Differences in the way social and economic groups value economic and non-economic services produced through the management of landscapes.
- Endogenous and exogenous agents of change.
- Power relationships among, individuals, coalitions, and public decision-makers.
- The efficacy with which the will of the people is transformed into the production of ecosystem services (*i.e.*, how well production reflects demand).

Thematic Areas:

- The sustainability of common pool resources
- The efficacy of place-based decision making
- Ecosystem valuation
- Transformative processes in the American West

Methodologies:

- Qualitative interviews
- Quantitative surveys
- Social network analysis
- Hedonic pricing models
- Agent-based models

Recent Research Findings:

Work is progressing on all fronts:
The Iowa State team has completed a major scoping survey to better understand resident's views related to land use, and the drivers/effects of land-use change on the quality of life. The survey instrument was mailed to 1200 residents from Beaverhead, Madison and Park counties in June 2007, with a response rate of 47.4%. Data summaries are complete and analysis of the data with a latent class model is underway.

Team members from The University of Arizona and Montana State University-Billings traveled extensively to observe regional planning processes (e.g., board meetings) and review archival materials. The Arizona group focused on planners and development officials, while the Montana group studied the dynamics of county commissioners, boards, and community action groups. These together have been used to investigate: 1) formal and informal institutions that are attempting to direct and control growth, 2) legal and extra-legal mechanisms for managing the environmental impacts of growth, 3) coalitions forming with interests in land use controls, and 4) differences in the development of such controls between counties at varying distances from growth nodes and key amenity sites.

Preliminary findings demonstrate that inhabitants have strong, and somewhat contradictory, views concerning access to public lands and individual property rights. Interviews and surveys suggest that the study counties are at different transitional stages. Major findings to date include:

1. A significant increase in demand for growth controls amongst planning officials and both long-term and recent local residents. County-level zoning is acceptable when it is a grassroots effort.
2. The composition of planning boards is slowly changing from individuals who represent traditional regional institutions to individuals who represent extra-regional and development interests.
3. Mechanisms for growth control are hampered by the legal/institutional systems established under earlier capital development regimes.
4. Differing attitudes toward open spaces and viewshed protection appear to have limited the success of regulatory solutions to the protection of common pool resources. The predominant institutional response has been largely *informal*, with planners and planning boards using mitigation requirements to set limited controls on subdivision practices.
5. Individuals and developers have responded to the lack of a comprehensive public approach to common pool resources management through covenants (private solutions to public issues).
6. Wealth plays a role – those who can most afford to own and protect the common pool resources do so.

Work at the University of Iowa has focused on the development of agent-based models designed to synthesize the economic, social, and political processes. Accomplishments include the integration of opinion development, and coalition formation into traditional decision-models based on utility maximization. Work has progressed on a computation framework to understand and evaluate the results of ABM simulations of complex, adaptive, spatial systems (Bennett 2007; Bennett and Tang 2008).

Presentation of initial findings to academic audiences is ongoing, results include:

Presentations

Bennett, D.A. (2007). “Representation and Interpretation: Challenges for Agent-based Models of Complex Adaptive Spatial Systems.” Plenary at Agent-based Modeling of Complex Spatial Systems. Santa Barbara. Invited.

Bennett, D.A. (2008) Panelist on Geocomputation and Agent-Based Modeling, GIScience 2008 Workshop on Temporal GIS. Workshop co-organizer.

Bennett, D.A. and Tang, W. (2008). ‘The Provenance of Complexity.’ Annual meeting of the AAG. Boston, MA.

Robbins, P. (2008). 'Closing the barn door after the horses have fled: Land use planning in the New West.' at Stanford Universty's Bill Lane Center for the Study of the North American West: Part of the 08-09 series: 'How the West was Spun- an interdisciplinary forum challenging traditional narratives of the North American West, its people and its environment.' Invited.

Robbins, P. (2008). 'Closing the barn door after the horses are gone: Land use planning in the New West' Annual meeting of AAG Boston, MA.

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Challenges and Opportunities:
Team logistics (e.g., finding mutually convenient times to meet and discuss) has proved challenging. To overcome this challenge we will rely more on web-conferencing. Other challenges are unique to the study area. For example, Montana is a non-disclosure state so needed real estate data is not readily available from public sources. Connections have been made with local real estate representatives and this is leading to effective cooperation between researchers and local business leaders. Still other challenges are scientific, specifically in terms of integrating project elements from a variety of expertise areas. We address integration both at the conceptual and technical level. For example, theoretical discussions with team members have led the ABM group to search for and incorporate techniques for opinion and policy development.

Project Title: DHB: Collaborative Research: Analyzing the Flow of Network-Embedded Expertise in Schools: A Longitudinal Study of Individual and Organizational Change

Project Numbers: 0624307 and 0624284

HSD Emphasis Area: Dynamics of Human Behavior

Principal Investigators: Kenneth A. Frank, Michigan State University and William R. Penuel, SRI International

Project Goals:

- How do formal opportunities for shared decision-making and informal opportunities for collaboration carry over or shift as a wave of pressure begins to take hold?
- How do interactions teachers draw on to respond to new institutional forces emerge from interactions regarding earlier reforms?
- Which interactions, experiences and attributes that emerged through prior reforms are most strongly related to teachers' responses to new institutional forces?

Thematic Areas:

- Intra-organizational diffusion
- Institutions
- Leadership

Methodologies:

- Quantitative models of Social networks
- Multilevel models
- Interviews and case studies

Recent Research Findings:

Our study focuses on how schools are responding to the Elementary and Secondary Education Act of 2001 (aka *No Child Left Behind*). In particular, we focus on how efforts to implement previous reforms affect the way schools respond to NCLB. We have used mixed methods, including case studies in six schools and social network data in eleven elementary and middle schools in a single state.

The study advances theory and knowledge of organizational change in education. First, our study elaborates the microfoundations of institutional theory (Powell & Colyvas, 2007) by illuminating the diverse ways actors respond to external pressure to change. These different responses imply that the success of accountability systems such as those created by NCLB in motivating change in individual behavior depends on leadership practices and intra-organizational dynamics.

We have three sets of findings from our case studies and quantitative analyses of networks and teachers' perceptions that describe how NCLB as an institution penetrates schools as social organizations:

Finding 1: Informal professional interactions related to instruction reflect primarily past, rather than current reform pressures, and there are more re-purposed than there are new organizational forms designed to address NCLB-related pressures.

Organizational structures that emerged from school reforms in the 1980's and 1990's are now being used to discuss NCLB-related concerns including how to raise test scores of low achieving students. In particular, grade-level and cross-grade teams, established in earlier waves of reform as a means to encourage teachers to plan instruction together, have been appropriated for NCLB-related concerns, such as increasing data-based decision making regarding instruction.

Past reforms and ties do influence patterns of help seeking with respect to NCLB. Rather than seeking out experts in reading and mathematics based on knowledge of colleagues' expertise, teachers rely on existing networks for help. These imply some stability with respect to the informal social structure of schools, as well as the importance of prior investments in relationship in teachers' access to help regarding instruction.

Interactions regarding reading and math are less frequent than interactions regarding reforms. This finding is significant, in that improvements in reading and mathematics are mandated by NCLB, and we have observed that in these schools in the past, talk about reforms is linked to implementation of reform.

Finding 2: Teachers tend to have limited knowledge of the specific requirements of NCLB; their attitudes toward it are complex and not easily predicted from institutional dynamics.

Teachers are aware of NCLB as part of the general institution of standardized testing and accountability, without particular attention to the differences between NCLB requirements versus state testing requirements. In contrast, principals and administrators are more aware of NCLB as a distinct social institution. Principals in case study schools actively buffered teachers from some pressures or introduced reforms that were in fact responses to NCLB without communicating their origins to teachers.

Teachers' do distinguish subgroups for whom they believe NCLB requirements are more or less fair. In particular, teachers tend to view requirements for English Language Learners and for students with disabilities as less fair than for other students. Their perceptions of fairness are related to their particular schools' challenges in meeting NCLB's requirements for Adequate Yearly Progress. In many of the schools in our sample, schools either had not met or were at risk for not meeting requirements for these two groups of students. The law's intent is to draw attention to groups in this way; teachers' response to it, though, is to judge the law as unfair because the targets for these groups seem to them to be unrealistic.

There is a disconnect between teachers' attitudes toward their local union organization and their attitudes toward the family of NCLB-related reforms. On the one hand, most teachers perceive there to be strong positive relationships between administrators and union representatives, but their attitudes toward some NCLB elements or proposed elements (e.g., merit pay for teachers), is consistent with national union opposition. Being an active member did not, in this sample of schools, predict attitudes toward NCLB, which contradicts Moe's (2003) prediction of universal opposition to NCLB by the union-dominated teaching force.

Finding 3: Coordinated and distributed leadership were related to deeper, more significant change efforts.

Analyses of leadership from a distributed perspective emphasize that leadership is not a set of personal attributes but a network of practices that is "stretched across" people, tools and processes, and situations (Gronn, 2002; Spillane, 2006). Schools in which leadership was distributed and coordinated were more responsive to NCLB throughout the school and in terms of changes in teachers' practices. This is consistent with general findings regarding the implementation of reforms (Desimone, 2002; Harris, 2005).

Each of these findings contributes to a description of how schools respond to institutions such as NCLB and through existing institutions such as unions. Schools do not respond en masse, with administrators sensing external institutions and implementing corresponding changes. Nor do school actors equally and independently perceive institutions and adopt them. Instead, new institutions can shape the very pattern of interactions in which teachers engage as previous reforms affect new (1). Concurrently, the sense teachers make of institutions is based considerably on experiences and interactions within their local contexts (2). These interactions affect teacher behavior in the classroom and coordination in the school. Ultimately then, school

responses to institutions such as NCLB emerge as leadership is distributed through the accumulation of interaction regarding work (3). Thus our findings empirically explore recent theoretical developments in the the microfoundations of institutionalism (Lounsbury & Crumley, 2007; Powell & Colyvas, 2007).

Thus the loose coupling and variable, individualistic behavior associated with schools can be attributed in part to how schools as social organizations respond to institutional pressures. That is, school cultures are not solely a function of bureaucratic organization or of lack of accountability (Meyer & Rowan, 1977), but instead are partly due to the institutional pressures they must navigate.

Challenges and Opportunities:

Our primary challenge will be to continue to track the effects of NCLB, many of which are just beginning to hit the schools we studied. Yet we have a great opportunity to fully understand the slowly emerging processes by which schools respond to the major institutional changes associated with NCLB. We also will have the potential to study how schools respond when there are changes in an institution or policy (such as could come with a new election).

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Project Title: Extreme Weather Events, State Interventions, and Pastoral Livelihoods: Social and Ecological Impacts of Spring Snowstorms on the Tibetan Plateau

Proposal Number: 0624315

HSD Emphasis Area: Agents of Change

Lead PI: Julia A. Klein, Colorado State University
Co-PIs: Emily Yeh, University of Colorado; Randall Boone, Kathleen Galvin, Dennis Ojima, Colorado State University
International Partners: Institute of Tibetan Plateau Studies, Chinese Academy of Sciences; Northwest Plateau Institute of Biology, Chinese Academy of Sciences

Project Goals:

- The main objective of this project is to investigate Tibetan ecosystem and herder vulnerability to extreme weather events (snowstorms), climate change, and grassland management policies under past, current and future conditions.

Thematic Areas:

- Global environmental change
- Coupled human-natural systems
- Pastoral human and ecological resilience/vulnerability to environmental change

Methodologies:
Our research involves three main activities: (1) in depth ecological experimental and ethnographic research in one location; (2) ecological observational sampling, structured/semi-structured interviews, and remote sensing across a broad spatial range; and (3) coupled ecosystem and agent-based modeling to capture multiple temporal and spatial scales.

- We are conducting an experimental manipulation where the treatments are: snow addition, warming, yak grazing, and pika exclusion. Through this controlled study, we can assess the independent and combined ecological effects of extreme weather events, climate warming, and grazing. Detailed, socio-economic studies will also reveal how decisions are made at the household level, how pastures and livestock are managed, and what factors influence strategies for recovering from snowstorms and adapting to climate change. In particular, the historical component will examine how strategies affecting resistance and resilience to spring snowstorms and climate change have changed over time within the larger political economic context, including changes in property rights, markets, and implementation of various development schemes.

- We are also investigating how socio-economic status, ecological range condition, and the presence/absence of state aid affect herder well-being and vulnerability to severe spring snowstorms and climate change. This investigation will be based on an evaluation of the effects of the 1998 ‘snow disaster’, using pre- and immediate post-storm data as well as data gathered on the current status of the coupled human-environment system. This will involve a suite of methods, including structured and semi-structured interviews, participant observation, ecological field observations, remote sensing, and historic climate analyses.

- We are using the field data to modify and parameterize a coupled agent-based and ecosystem model to reflect the interactions of climate, extreme weather events, ecological conditions, pastoral management patterns, state policies, and socio-economic conditions on the Tibetan Plateau. We will make predictions of future herder well-being and vulnerability to future extreme spring snowstorms and climate change under a suite of snowstorm frequency and intensities, management practices, and state policies.

Recent Research Findings:

Snowstorm histories and climate analyses: linking indigenous knowledge to field observations, modeled and remotely sensed scientific data: Last year, we obtained archived records on snowstorm histories from 1827 to 1957 and the pre-1950 government response to those snowstorms. This information complements the government reports we had previously obtained on the history of snowstorms and state responses from the mid 1950s to the present and the primary data we collected on state and NGO aid in response to 'snow disasters' within the last decade. This past summer, two Tibetan students working on the project interviewed herders in two different regions of the Tibetan Plateau to obtain indigenous knowledge of climate, climate change (temperature, precipitation, snowstorm intensity and frequency) and reliability of climate predictions. We are beginning to analyze these data and compare them with the historic climate information we obtained through Chinese meteorological stations, the Climate Research Unit (CRU) dataset, and remotely sensed Advanced Very High Resolution Radiometer (AVHRR) Pathfinder data. We are employing the AVHRR dataset to characterize the spatiotemporal dynamics of snow cover throughout the Tibetan Plateau, and at our specific research sites.

Ecological Experiment: This past summer, we identified the site where we will establish our experimental manipulation: the Nam Co Monitoring and Research Station for Multisphere Interactions (N30˚46.44', E90˚59.31', 4730 m). This station is operated by the Institute for Tibetan Plateau Studies (ITPS), Chinese Academy of Sciences. We also developed a collaborative research agreement with ITPS regarding this aspect of our project. Our treatments will be snow addition, warming, yak grazing, and pika exclusion. Treatments will be crossed in a factorial manner with four-fold replication. We discussed our yak grazing protocol with several herders this summer to confirm that the size and shape of our grazing plots will be appropriate for yak grazing. PI Klein, Bump (postdoctoral fellow) and Hopping (PhD student) will travel there in mid-October to set up the experiment.

Coupled Ecosystem-Agent Based Model: With leveraged support from NSF project DREAMAR (SES-0527481 to Galvin et al.), we have made rapid progress in developing the DECUMA model, our agent-based model of livestock-owning households. An initial version of the model was programmed in Java, which helped us create the logic for successful simulations. For parameterization and use of the model, we created another version, in FORTRAN, which is more efficient and more flexible. We also created a Visual Basic graphical user interface for the linked household and ecosystem model, which allows users to view data as the models are running, rather than waiting until lengthy simulations complete. We have created the first comprehensive agent-based model of livestock-owning households, linked to a spatially explicit ecosystem model (SAVANNA). This past summer, we collected the ecological and socio-economic data for the coupled model. We are currently using the data to parameterize the linked model; this will be the first application of the coupled model to the Tibetan Plateau region.

Challenges and Opportunities:

Challenges: Our biggest challenge this past year was the government response to the protests on the Tibetan Plateau. Beginning in March 2008, the Chinese government prohibited all foreigners from entering Tibet. On July 1, the government opened Tibet to tour groups, but not to researchers. We were, therefore, not able to conduct our big field campaign this summer. We (PI Klein and PhD student Hopping) were able to travel into Tibet as tourists, to examine several potential sites for the ecological experiment and to meet with potential collaborators in the different regions of the Plateau. We have heard that Tibet is now open to researchers, so Klein, Hopping and Bump (postdoctoral fellow) are planning to travel to the region to set up the ecological experiment in mid-October. We have also just learned that the Chinese will not allow us to take soil and plant samples out of China. This is a new challenge we are facing. We will have to make adjustments in our protocols to accommodate this policy.

Opportunities: Through the process of investigating all potential sites for the ecological experiment and the detailed socio-economic-political study, we have extended our connections to

academic institutions and political jurisdictions beyond those which were included in our original proposal. Our network of potential collaborators has grown and will serve to only strengthen this project. One of our new contacts is a professor at Tibet University. We are discussing the possibility of having students from Tibet University participate in this project; this is a new and welcome opportunity for our project.

Project Title: DHB: Exploring Educational Policy and Change from a Complex Systems Perspective

Proposal Number: 0624318

HSD Emphasis Area: Dynamics of Human Behavior

Lead PI: Dr. Uri Wilensky, Northwestern University
Co-PIs: Dr. Luis Amaral; Dr. Louis Gomez, Northwestern University
Collaborators: Michael Barber, Dr. Roger Guimera, Spiro Maroulis, Hisham Petry, Dr. William Rand, Michael Stringer, Peter Wardrip, Northwestern University

Project Goals:

- This research concerns the creation of new kinds of tools for understanding and characterizing school reform initiatives. By utilizing the strengths of two new modeling and analysis techniques – agent-based modeling and social network analysis -- we address the following overarching question: Why, despite so much individual level effort and activity, system-level change is so difficult to achieve? More specifically, in this effort we will model and analyze the problem of understanding the emergence of system-level change in the context of three cases of reform initiatives: school choice, small schools reform and individualized instruction through tracking.
- A second area of focus is to better understand how patterns in home location, classroom composition/structure and extra-curricular activities affect academic achievement/college outcomes. Using archival data from urban high schools our goal is to use individual modeling methods to get at the effects of these groupings on social structure and how that local structure mediates achievement.

Thematic Areas:

- Agent-based Modeling
- Social Network Analysis
- School Reform

Methodologies:

Agent-Based Modeling (ABM)

- Social Network Analysis (SNA)
- Hierarchical Linear Modeling (HLM)
- Clinical and Task Interviews—questions and tasks
- Integration of symbolic modeling with agent-based modeling
- Geographic Information Systems (GIS)
- Dynamic Network Visualization

Recent Research Findings:

- Using data collected from a complete network of adolescents in one large, urban school engaged in a small schools reform, we find that the academic performance of peers is "contagious." Moreover, we find that this peer effect is easy to miss if one only looks at the average effect. Instead, we find evidence that peer effects are moderated by network structure, with students in highly dense networks of friends subject to stronger contagion.
- In our HLM analysis of historic achievement data from Chicago Public Schools, we find that the amount of the variance in high school student achievement that can be attributed to differences is schools is approximately 45%, but decreases to about 10% when controlling for prior achievement. Although small, there seem to be statistically significant differences in school effects across schools that are stable over time.
- Using SNA of enrollment patterns in Chicago Public schools, we have also confirmed that, for the most part, students are indeed leaving low achieving schools for higher achieving

schools, with higher achieving students more likely to choose not to attend their assigned school.

- Initializing an agent-based model with the above two empirical results has led to an additional finding. A popular research question in the school choice literature is to compare the performance of choosers and non-choosers. Often this is done through field studies taking advantage of the lotteries put in place to deal with oversubscription to choice programs have not had much success in finding conclusive evidence on the programmatic effect of choice programs; but often with mixed results. Reasons for the inconclusive results in debates about the self-selection and confounding when estimating a "programmatic effect." Analysis of our model provides an explanation of why disparate results should perhaps be the expectation in such studies even with a perfect research design because of the variability in the better available capacity across schools in a district.
- Using GIS tools and methods combined with NetLogo-based agent and link tools, we have constructed dynamic visualizations that readily reveal patterns in student data. In our most recent high school study, we have received demographic data, census blocks, and achievement scores for students. The full roster data (including grades and courses), and the extra-curricular participation data is still pending. One visualization we have constructed visualizes test scores over a map of the area to identify patterns in achievement. It shows test scores for 9^{th}, 10^{th}, 11^{th}, and 12^{th} grade Explore, Plan and ACT exams. Using a red-yellow-green streetlight-coloring scheme, the visualization highlights the differences in scores based on location as well as ethnicity and enables visualization of data queries.

Challenges and Opportunities*:*

- With respect to our work on school choice, a challenge is obtaining data that can give us a greater understanding of how households decide which schools to attend. This information can then be combined with our school effects finding in an agent-based model of school choice in Chicago that gives us a better idea of what emergent outcomes are reasonable to expect in choice-based reforms. Our efforts in this regards are ongoing – the better our understanding of individual choice "mechanisms", the better our model will be
- With respect to our work on school choice, our work has been largely limited to the analysis and modeling of "public" choice programs – programs that do not allow for the flow of money to private institutions. Future research could expand this focus and collect data and create models of more far-reaching voucher programs. Additionally, our current work has treated individual choice as an experimental parameter. Future work could focus on collecting primary data on household preferences for school characteristics.
- With respect to our work on peer effects, the primary challenge is to investigate our initial findings in other settings and to conduct comparative analyses. Our current findings come mostly from data collected in one school. This aspect of our work has implications for all of our research settings and questions and we have an opportunity to compare effects across our different research studies such as small schools reform, which attempts to change student social structure, and tracking reforms which group students by ability levels.

Project Title: Archaeological Data Integration for the Study of Long-Term Human and Social Dynamics

Proposal Number: 0624341

HSD Emphasis Area: Agents of Change

Lead PI: Keith Kintigh, Arizona State University
Co-PIs: K. Selçuk Candan, Hasan Davulcu, Margaret Nelson, Katherine Spielmann (Subbarao Kambhampati)
International Partners: Maria Luisa Sapino, Università di Torino

Project Goals:

- ***Build a prototype information infrastructure*** for systematically collected archaeological data that will
  - permit data-based synthesis across projects employing inconsistent recording protocols,
  - maintain the long-term utility and accessibility of irreplaceable primary data in the face of inadequate metadata and rapidly changing technology, and
  - establish the capacity to build and access a worldwide archive of primary data representing the full history of human use of animals.
- ***Foster disciplinary awareness*** of the research value of data integration, the need for comprehensive metadata, and the importance of long-term data preservation.
- ***Investigate the socioenvironmental conditions*** that lead to depressed abundance of preferred game—over two millennia in two US regions—as a part of the testbed research.
- ***Provide scholars in diverse fields with meaningful access*** to long-term data on society, population, and environment, archaeology can help explain the complex human and social dynamics that have constituted today's social world and shaped the modern environment.
- ***Advance socioecological modeling*** efforts and allow scientists to address large-scale and long-term social and natural science questions though the use of concept-oriented queries of this archive
- ***Develop computational tools*** for concept-oriented, query-driven data integration in the presence of inconsistent data source ontologies and inconsistent analyst ontologies that will be applicable to other science informatics domains in which complex inferences need to be made over multiple heterogeneous, inconsistent, and context-dependent sources.

Thematic Areas:

- Archaeological synthesis; archaeological fauna; species diversity
- Science informatics:
  - data integration
  - data sharing, and
  - long-term data preservation

Methodologies:

- The prototype digital archive provides user-oriented metadata acquisition tools that allow users to upload datasets and enter the necessary metadata to enable data integration and the long-term preservation and use of the datasets.
- The prototype employs newly developed metadata standards that build on existing standards to document both projects and individual information resources and to document table- and column-level metadata necessary to encode the semantics of the database in a form that is machine processable.

- We are developing novel computing strategies to extract integrated data from multiple, inconsistently recorded databases, making use of table- and column-level metadata for databases along and codified expert knowledge in the data domain.
- We are moving to employ Fedora as a platform for the data archiving and management.
- We have acquired a number of archaeological faunal datasets from the Southwest and Midwest US along with associated metadata to for the proposed testbed research.

Recent Research Findings:

- We have drafted a comprehensive metadata standard.
  - The draft standards for top level (project and dataset) metadata facilitate interoperability with other relevant systems.
  - We have made considerable progress on the specification of column and value-level metadata and have a working model that will likely undergo further development.
- The archive, the first stage of the information infrastructure, is now on-line and available at http://tdar.org (tDAR stands for "the Digital Archaeological Record"):
  - The tDAR code base employs the draft metadata standards.
  - It includes an information resource upload and metadata acquisition tool that collects metadata for databases at the level of the table, column, and value.
  - It includes a web-based discovery and access interface that can locate information resources of interest through queries of the metadata and data content.
  - The archive has some context-aware search capabilities that make use of dataset and user ontologies.
- In the context of this and a closely related planning grant from the Andrew W. Mellon Foundation, we have developed a much more detailed software design specification. This includes development of user-oriented specifications and development of technical specifications.
  - We have developed an ontology-based design for metadata acquisition that will facilitate dataset registration and preserve subtle distinctions of absence vs. missing data.
  - The same ontology structure will be used in to match the semantic demands of a query with the semantic content of available data sources.
- We have developed partial ontologies for key domain topics.
- Specific methods for identifying and resolving inconsistencies in alternative ontologies have been developed and presented in multiple professional outlets.
- We have accomplished considerable disciplinary outreach and have found that there is considerable interest in this initiative and support to institutionalize broad requirements (consistent with archaeological ethics and Federal regulation—36 CFR 79) for the deposit of research data.

Challenges and Opportunities:

PI Kintigh leads a separately funded multi-institutional collaborative, archaeoinformatics.org, that is planning the development of a more expansive information infrastructure for archaeology to be built on the platform developed by the HSD project. This is an important opportunity as its efforts focus on the organizational and sociological dimensions of cyberinfrastructure development and on software development for text and images that are not central to this HSD effort. A full implementation proposal for this initiative has been developed and is under consideration by the Andrew W. Mellon Foundation.

Project Title: Collaborative Research: Parks as Agents of Social and Environmental Change in Eastern and Southern Africa

Proposal Numbers: 0624343 (McCabe); 0624226 (Goldman); 0624265 (Leslie)

HSD Emphasis Area: Agents of Change

Lead PI: J. Terrence McCabe, University of Colorado at Boulder
Co-PIs: Abe Goldman, Mike Binford and Brian Child, University of Florida; Paul Leslie, University of North Carolina - Chapel Hill;
Collaborators: University of Dar es Salaam, Tanzania; Makerere University, Uganda; University of Namibia; University of Zimbabwe; Harry Oppenheimer Okavango Research Centre; Botswana Wildlife & Natural Resources Department

Research Goals:

1. To examine the ways in which parks act as agents of change in eastern and southern Africa.
2. To establish the types and phases of response by local households and communities to the constraints and opportunities associated with parks and the relationships among responses.
3. To clarify how responses to costs and benefits, constraints and opportunities associated with parks contribute to transformation of local social-ecological systems (SES) and whether and how they create the conditions for more widespread transformations.
4. To establish the range of differing responses and impacts of parks across varying ecological, demographic, and policy contexts in different countries and identify the factors that lie behind these variations.

Thematic Areas:

1. A *focus on human agency and process* as central to understanding a social-ecological system (SES), both by considering the perceptions and decision making that drive action, and by considering the consequences of that agency for the SES, which includes the park and surrounding areas. We take agency to comprise actions that implement decisions by individuals and social entities such as families and communities. This implies a need to understand the perceptions and decision making processes that inform and produce those actions.
2. An examination of the dynamic processes by which parks precipitate and accelerate transformation of social-ecological systems under diverse circumstances. We expect that the impacts of parks progress through a series of stages. In these *phases of response,* we expect that early response entails a period of *accommodation* followed by a phase of *adaptation*. The first phase is short term with little in the way of longer-term implications. The second phase is likely to entail new adaptive behaviors, strategies, social practices, and/or institutions. The third phase may result in a significant *system transformation and reorganization* as further changes are induced in both the social and biophysical realms of the SES. This may produce a new set of relatively stable conditions in the immediately affected areas. In the fourth phase, the impacts radiate outward as the direct effects of the park diffuse and indirectly affect more distant areas.
3. Consideration of *response diversity* -- individual- and community- level heterogeneity in responses to parks. Response diversity may have important longer term implications for system resilience.
4. Consideration of *actions at multiple levels*, which may sometimes have opposing objectives and consequences.

Methodologies:

1. Focus group discussions, open-ended interviews, and participatory mapping;
2. Household surveys;
3. Analysis of decision-making and distribution of benefits ;

4. Time series analysis of land use, land-cover change, and landscape fragmentation analysis.

Recent Research Findings:
Researchers spent the last year collecting data in all three areas: Uganda, Tanzania and Namibia/Botswana. Project meetings focused on the progress of data collection and the need to create similar databases across sites. Analysis of data on risk-perception, livelihood strategies, and attitudes towards parks and conservation continued. Collection of data on vegetation, soils, hydrography and biodiversity continued from the first year of the project. Research findings specifically addressing the research hypotheses are still being developed. The PI's have identified the comparison of conservation narratives in all four countries as an important component of the current work. Efforts are underway to get this analysis done.

Challenges and Opportunities:
One of the major challenges has been the comparisons across sites. Co-PI's working in Uganda and Tanzania planned to visit the southern African field sites. During field research conducted this year, J Terrence McCabe visited field sites in Botswana and Namibia. Teams of researchers from the University of Florida and universities in Botswana and Namibia are conducting research there along with members of African NGOs. This trip has helped the Principal Investigators understand the similarities and differences among the different field sites.

By using additional funding sources, including successfully encouraging a large proportion of our students to source their own research, we are building an integrated, inter-disciplinary learning group that includes some 20 scholars, multiple African universities, and practitioners. This is laying a foundation for long-term collaborative, inter-disciplinary adaptive management and monitoring as well as a significant multi-variable database.

Project Title: The Dynamics of Human-Sea Ice Relationships: Comparing Changing Environments in Alaska, Nunavut, and Greenland
Working Title: *Siku-Inuit-Hila Project* "Sea ice-People-Weather Project"

Proposal Number: 0624344

HSD Emphasis Area: Dynamics of Human Behavior

Lead PI: Shari Gearheard, University of Colorado at Boulder
Co-PIs: Roger G. Barry (CU-Boulder); Henry Huntington (Huntington Consulting)
Collaborators/International Partners: Andy Mahoney (CU-Boulder/Univ. Otago, New Zealand); Yvon Csonka (Ilisimatusarfik – University of Greenland); Lene Kielsen Holm (Inuit Circumpolar Council-Greenland); Toku Oshima (Qaanaaq, Greenland); Mamarut Kristiansen (Qaanaaq); Qaerngaaq Nielsen (Savissivik, Greenland); Joelie Sanguya (Clyde River, Nunavut, Canada); Igah Sanguya (Clyde River); Ilkoo Angutikjuak (Clyde River); Geela Tigullaraq (Clyde River); Warren Matumeak (Barrow, Alaska); Joe Leavitt (Barrow); Nancy Leavitt (Barrow); Barrow Arctic Science Constortium; Community of Clyde River; Qaanaaq Kommunea; North Slope Burrough; Inuit Circumpolar Council-Greenland.

Research Goals:

1. Characterize sea ice and its use by humans at each location (e.g., seasonal patterns of use, use of specific features and zones, role of thickness in various activities, etc.);
2. Document changes to sea ice, with particular attention to the features most crucial for human uses (e.g., seasonality, shorefast ice formation, roughness, etc.);
3. Document change in human use patterns over time (e.g., effects of modernization in recent decades, effects of hunting regulations, effects of climate change, etc.);
4. Recent human responses to changes in sea ice (e.g., acquisition of new knowledge, changes in hunting patterns, changes in equipment, etc.);
5. Document impacts from sea ice changes and human responses (e.g., reduced role for elders as old knowledge becomes less relevant, changes in harvest patterns, increased risk, greater reliance on regional government, etc.);
6. Understand implications for future changes, impacts, and adaptations (e.g., shifts in hunting patterns, reliance on new technology, changes in regulatory regime, etc.).

Also:

1. Establish a working research team of interdisciplinary scientists, and Inuit, Inughuit, and Iñupiat hunters to work together to study sea ice, bringing indigenous and scientific knowledge and perspectives together;
2. Establish methods and approaches to link indigenous knowledge and scientific measurements to characterize sea ice and assess sea ice changes;
3. Produce creative research products, in particular, a sea ice encyclopedia documenting sea ice terminology and knowledge from 4 cultures/languages: Inuktitut, Iñupiat, Kalallit (Greenlandic), and science/English (also Danish).

Thematic Areas:

- Sea ice
- Inuit
- Indigenous knowledge / traditional knowledge
- Climate change
- Linking science and indigenous knowledge

Methodologies:
Our methodology has a three-pronged approach. These methods collect information in different ways, but all complement one another and help to build a more complete picture of local-scale sea ice conditions and use as well as changes in both of these:

1. *Knowledge exchanges*: Three representatives from each participating Arctic community involved, along with project scientists, form a unique research team of people with different backgrounds, expertise, and experience. As a team, we travel to each of the three communities where we meet with local experts and learn about local sea ice conditions and sea ice use. The emphasis is time spent on the sea ice, learning about and engaging in local activities.
2. *Sea ice data collection*: Up to four sea ice measurement stations are operating (during the sea ice season) at each community location. The stations are used to measure the thickness and temperature of sea ice and snow on a weekly basis. These measurements help quantify the sea ice regime at each community in terms of ice growth and melt, snow accumulation, and the timing of the annual cycle. We have trained local people in each community how to install these stations and take the measurements.
3. *Sea Ice Expert Working Groups*: In each community, we have established a working group of local sea ice experts who meet once per month. They discuss the latest sea ice conditions, document changes they observe in the sea ice, and review the data from the sea ice monitoring stations. They work on other activities such as documenting local sea ice terminology and creating local sea ice calendars – e.g. stages of freeze up and break up, and use of sea ice over the sea ice season. The group also works on mapping local/regional sea ice changes and use.

Recent Research Findings:

- The last project knowledge exchange (see 1 above) was held in Clyde River in April, 2008 and was a huge success. Our experiences in this exchange solidified for our team that the knowledge exchange approach is extremely valuable in this type of research. Travelling and living together, particularly on the sea ice, has created strong bonds between diverse team members. Being in direct contact with our subject, sea ice, provided a means for people to directly and clearly relate to the varying knowledge, perspectives, and experiences about sea ice offered by different team members.
- July 2008 marked the end of our second year of community-based sea ice monitoring (2 above). Through this data collection we have found some interesting similarities and differences in the local sea ice environments. At Qaanaaq, we have been able to document the timing and impact of warm ocean currents in spring, that thin sea ice quickly from below, a phenomenon that experienced sea ice users say is new to the area. At Clyde River, we find that the sea ice continues to get thicker very late into the spring much later than at Qaanaaq or Barrow, but then thins dramatically and breaks up quickly. We are investigating further the relationships and mechanisms that cause these processes and are similar or different between places. Using the sea ice expert working groups, we can combine local and scientific knowledge.
- The sea ice expert working groups in each community have been very active in the project, meeting monthly over the sea ice season. The groups have been able to construct seasonal calendars of local and regional sea ice use that we are also mapping and comparing across communities, and documenting the impacts of sea ice changes on these calendars. The groups also discuss the findings of the sea ice monitoring work at the meetings, to help aid in interpreting the data – the mechanisms and causes of sea ice processes and change.
- We continue to document sea ice terminology in the project, using the 5 different languages of the project – Inuktitut, Iñupiat, Kalaallit (Greenlandic), Danish, and English. For example, in Clyde River, we have collected 83 terms for sea ice that will be added to a comparative sea ice encyclopedia we are creating.
- Data collection, analysis, and writing will take place in the sea ice expert working groups over the next year (over the next sea ice season) and sea ice monitoring continues for the 2008-2009 sea ice season as well.

Challenges and Opportunities:

- We believe there is a good opportunity to expand the sea ice monitoring system we developed in this project. We have developed a comprehensive manual for the method (see new publications below) and the method has been refined over 2 years use in our communities. We are currently working with the Government of Nunavut regarding opportunities to create a Nunavut-wide sea ice monitoring network based on the methods we have developed.
- With strong bonds in the research team and excellent momentum in data collection and analysis, the challenge is to continue the work. All team members are hoping that the project can continue after the HSD period is complete. It takes so much time to establish the relationships needed to do this kind of work, and with that well in hand, the team feels that we can go much farther in our understanding. We hope to be successful in identifying and applying for continued funding.

New Publications:

Mahoney, A., Gearheard, S., Oshima, T., and Qillaq, T. 2008. Sea ice thickness measurements from a community-based observing network. *Bulletin of the American Meteorological Society*, (TBD).

Mahoney, A. and Gearheard, S. 2008. Handbook for community-based sea ice monitoring, NSIDC Special Report 14, Boulder, CO, USA: National Snow and Ice Data Center. http://nsidc.org/pubs/special/nsidc_special_report_14.pdf.

Project Title: The Dynamics of Probabilistic Grammar

Proposal Number: 0624345

HSD Emphasis Area: Dynamics of Human Behavior

Lead PI: Joan Bresnan, Stanford University
Co-PIs: Daniel Jurafsky, Michael Ramscar, Thomas Wasow

Project Goals:

- Study probabilistic variation in high-level linguistic choices across time and space
- Study interactions of low-level pronunciation choices and high-level grammatical choices
- Study language learning across the human life cycle, modeling behavioral differences between children and adults

Thematic Areas:

- Syntactic alternations (word order and optional elements)
- Variation in word durations, pauses, and pitch
- First and second language learning of morphology and syntax

Methodologies:

- Corpus studies (synchronic and diachronic)
- Psycholinguistic experimentation (judgment studies, reading times, eye-tracking)
- Language learning studies (with both natural and artificial languages)

Recent Research Findings:

1. Naturalness judgments reflect probabilistic predictions of models based on corpus data across dialects.
2. Listeners use verb biases to anticipate upcoming material.
3. Ease of processing affects historical word-order change.
4. Structural priming shares crucial properties with lexical priming.
5. Frequency, contextual predictability and repetition make separate contributions to word duration.
6. More informative phones are longer and less likely to be deleted
7. Usage frequency influences tone and pitch range in Cantonese.
8. The duration of words and pauses reflects speakers' knowledge of syntactic probabilities.
9. Translatability into one's first language affects learning of names in a second language, but only for people learning the second language late.
10. Learning determiners and nouns is facilitated by exposure to them in whole sentences.
11. Children over-regularize early in acquisition because the representations of frequent, regular plural forms develop more quickly, initially interfering with irregular forms.
12. People recognize frequent 4-word sequences faster than less frequent ones.
13. The dative alternation in child language exhibits striking qualitative similarities to, and smaller quantitative differences from, its statistical pattern in adult language.

Challenges and Opportunities:
The biggest challenge and the biggest opportunity are the same: extending the spatial and temporal dimensions of our investigations into language variation. It is an opportunity because we have so far only looked at a few dialects of a few languages, and have looked at temporal scales of milliseconds and centuries, but little in between. Extending these dimensions will be challenging because corpus materials (especially richly annotated corpora) of other languages, dialects, and periods are much harder to obtain, and running experiments on longer time scales is also difficult.

Project Title: Market Creation as a Policy Tool for Transformational Change

Proposal Number: 0624354

HSD Emphasis Area: Agents of Change

Lead PI: Robert Lempert, RAND
Co-PI: Steven Popper, RAND
Collaborators: Barry W. Ickes, Penn State and Edward Parson, University of Michigan

Project Goals:

Economics provides an excellent understanding of the efficiency-enhancing potential of markets, but the introduction of markets often also leads to a transformation of a society's values, incentives, and institutions. We call this a market-induced transformation. This project aims to study how market-induced transformation can be included and exploiting in policy analysis. Specifically, this project seeks to:

1. Integrate and advance the understanding of market-induced transformations. We will examine how the potential for such transformations can lead to different outcomes (some beneficial some perhaps less so) than might be expected when considering only the most narrowly defined efficiency-enhancing potential of markets.
2. Exploit this understanding by developing a set of policy analytic tools to compare and assess the effects of alternative policies that seek to achieve their goals by fostering market transformations. In particular, we will examine how consideration of market-induced transformation might affect the appropriate design of policies to reduce emissions of climate-changing greenhouse gases.

Thematic Areas:

1. Climate change policy raises time-inconsistency problems. Since current policymakers cannot bind their successors, any near-term policy decision must consider that future policy makers may not make optimal choices. In this study we examine how near-term market creation may affect what the political science literature calls the sustainability of reform, that is, the conditions under which general interest policy reforms are and are not sustained over time.
2. There is currently vigorous debate over the appropriate design of policy interventions to reduce greenhouse gas emissions, for instance, the proper balance of standards, taxes, and trading systems. We will study how the consideration of market-induced transformations may affect the assessment of such policy designs.

Methodologies:

This project will address these questions with three interlaced research tasks: 1) examine case studies of market-induced transformations initiated by past policies; 2) evaluate and modify as necessary several theoretical frameworks and their corresponding mathematical models that aim to capture the key features of such transformations; and 3) calibrate these models against the phenomenology expressed in the case studies and use them to establish a decision tool set for assessing and comparing policies using market transformations against other possible policy approaches.

To date, our case studies have focused on instances of market creation as a regulatory instrument, including transferable fishery quotas in Canada and New Zealand; various environmental markets (e.g., various markets in emissions, wetlands preservation, conservation easements, and debt-for-nature swaps); transferable tax credits intended to motivate investment and scientific research; and taxi medallions. In addition, a conceptual study has sought to identify the principal dimensions of variation among different types of environmental markets and explored expected behavioral differences and associated policy challenges.

We have also been examining three sets of simulation models to explore themes of market creation, transformation, and the implications for near-term policy design for the mitigation of greenhouse gases.

First, we are using a simple model that compares the differential impacts of carbon taxes as opposed to cap and trade regulatory systems on energy efficiency investments in the consumer-housing sector. We combine an economic model with a simple model of voter preferences as they are affected by the two regulatory systems, in particular the fact that the cap and trade system can grant property rights in emissions reductions through the sale of offsets, and examine the comparative dynamics of the two systems over time.

The second simulation exercise examines the role of anticipated research into a backstop technology on the production of fossil fuels and thus carbon emissions. Using the theory of optimal extraction of an exhaustible resource, we examine how the combination of regulations and research affect the long-term trajectory of carbon extraction.

The third simulation uses a simple evolutionary economics formalism to explore the ability of near-term market-based policies to launch a longer-term transition of an economy from a high emitting to a low emitting state. The current model examine conditions under which an industry with three types of firms -- *green firms* choose to make costly investments to become green; *conventional firms* choose to remain polluting; and *intermediate firms* act green but do not make the actual investments -- will evolve into an all-green equilibrium, or become trapped in some other state.

Recent Research Findings:
Several initial findings have emerged from the case studies, including: i) initial definitions of markets and associated property rights have high stakes and frequently involve large transfers of wealth, often including consolidation or exclusion of historical actors in the now market-regulated resource or activity; ii) environmental resources are characterized by fuzzy boundaries and systemic effects, while newly defined environmental markets often impose bright-line boundaries, so that holders' organized interests in protecting the value of their assets may consequently increase pressure on nearby, linked resources; and iii) efficient, liquid markets require that the items being exchanged are sufficiently standardized for easy measurement and comparison, but the environmental behaviors being regulated vary on multiple dimensions relevant to impacts, thus imposing a tradeoff in environmental market design between achieving liquidity and ensuring equivalence of traded assets, possibly with associated opportunities for arbitrage that might impair attainment of environmental goals.

Initial runs of the household efficiency simulation suggest that in most cases both the carbon tax and cap and trade policies generate similar emissions and costs to households. But when carbon prices are high and efficiency investments expensive, the cap and trade policy may generate larger incentives and thus lower emissions than under the carbon tax policy, but the carbon tax policy may lower costs by returning a higher fraction of carbon tax revenues to households.

Initial results for the backstop technology simulation studies suggest that research on such technologies encourages fossil fuel owners to supply more of their resources in the near future because they anticipate that their resources will become obsolete before it is depleted. Thus, while backstop technology research offers the promise of an eventual decrease in carbon emissions, it can create a cost in the form of higher present day greenhouse gas emissions.

Challenges and Opportunities:
This project aims to provide important contributions to both scholarly and current policy debates. The primary challenge remains integrating the pieces into a coherent whole.

Project Title: Large-Scale Analysis of Computer-Mediated Relationships

Proposal Number: 0624356

HSD Emphasis Area: Dynamics of Human Behavior

Lead PI: Marti Hearst, UC-Berkeley
Co-PIs: Coye Cheshire and Gerald Mendelsohn, UC-Berkeley

Project Goals:

- To study relationship formation and development on a large scale, using a sizeable online personals (dating) website.
- To conduct a longitudinal analysis of individuals who currently use the online personals website.
- To follow communicating dyadic partners over time (before they meet in person, after their initial face-to-face meeting, and on to further relationship development if applicable).
- To shed new light on key areas, including: (1) the role of personality and attitudinal similarity in long-term relationship satisfaction, (2) the balance between positive and authentic self-presentation for relationship formation, (3) the effects of computer-mediated communication on interpersonal relationship formation.

Thematic Areas:

- Social Psychology of Relationship Formation, Development and Satisfaction
- Quantitative Sociology
- Human-Computer Interaction
- Computer-Mediated Social Interaction

Methodologies:

- Longitudinal survey of users and dyadic partners
- Text Analysis of online profile descriptions
- Experimental studies of perceived attractiveness in online dating profiles (text and photographs)

Recent Research Findings:
The following is a brief summary of some preliminary results from the responses to our first questionnaire. We are interested in various aspects of gender differences, mate selection, attractiveness, trust, and other factors. As the literature on mate selection would suggest, heterosexual men were seeking a younger partner on average (–4.1 years), while heterosexual women were seeking a slightly older partner on average (+1.1 years).

We also analyzed the Big Five personality traits of consenting users and the traits they would like in an ideal partner. In general, women described themselves and their ideal partners in more socially desirable ways — higher on agreeableness, conscientiousness, extraversion, openness to experience, and our new item, “Genuine, trustworthy,” and lower on neuroticism.

Additionally, we found that men were more interested in casual dating than women, while women were more interested in friendship, marriage/civil union, and serious dating. Men and women did not differ significantly in adult attachment style or dispositional trust, though women were slightly higher than men in dispositional caution.

Following are brief summaries of the results from our related studies:

Laboratory study of profile attractiveness. As part of our effort to understand what makes an online dating profile attractive, we broke 50 profiles into their three primary components — a photo, fixed-choice demographic descriptors, and free-text self-description. We had participants

rate each of these components and the whole profiles on their overall attractiveness and seven other dimensions: extraversion, masculinity, femininity, genuine/trustworthiness, agreeableness, self-centeredness, and self-esteem. We then analyzed the responses to determine which qualities of which components predicted overall attractiveness of the whole profiles. This work was published as a full paper and presented at ACM Computer-Human Interaction 2008.

Results: We examined how users perceive attractiveness in online dating profiles, which provide their first exposure to a potential partner. Participants rated whole profiles and profile components on such qualities as how attractive, extraverted, and genuine and trustworthy they appeared. As past research in the psychology of attraction would suggest, the attractiveness and other qualities of the photograph were the strongest predictors of whole profile attractiveness, but they were not alone: the free-text component also played an important role in predicting overall attractiveness. In turn, numerous other qualities predicted the attractiveness ratings of photos and free-text components, albeit in different ways for men and women. The fixed-choice elements of a profile, however, were unrelated to attractiveness. Finally, we found that the predominance of the photo as a determinant of ratings of attractiveness holds for both men and women. The results of this study are important and interesting in their own right, but they also provided the insight that directly led to our inclusion of questions in our primary study that assess extroversion and trustworthiness in attraction.

Analyzing Language Use to Inform Attractiveness Studies. The goal of this sub-project was to analyze language usage in Online Personals profiles in order to inform attractiveness studies. Previous studies have found correlations between language use and the big-five personality traits. Language use has also been shown to be an individual distinguishing factor. Our past work on associating attractiveness with online personals also showed correlations between perceived attractiveness and contents of a personals profile. We hypothesized that in online personals, language use plays an important role in perceived attractiveness and likeability. While attractiveness/likeability is a subjective impression, we hypothesized that if certain personality characteristics were explicated by language use, these would have effects on attractiveness scores. We first characterized language usage and looked for correlations with extreme personality traits (and therefore likeability). We used profile text from adult heterosexuals (500 males and 500 females). Using word classes from Language Inquiry Word Count (LIWC) we found percentage of word classes used in a profile. Underlying dimensions of the LIWC variables within these profiles were further studied using exploratory factor analysis.

Results: The largest variation in both men's and women's profiles was a linear combination of the LIWC variables - pronouns, verbs, first person singular pronouns, present tense words and auxiliary verbs. This is not surprising given the nature of this domain where self-presentation often involves the use of first person pronouns (I) and auxiliary verbs (am, will) and present tense words. The second largest pattern in men is explained by words in the sexual, affect, positive emotion and biological process LIWC classes. In women, a similar pattern in observed. However, this factor in women is also characterized by a low usage of space and relativity class words. Space and relativity have in the past been associated with concrete styles of writing. We further looked at profile types based on their scores of the underlying factors. The use of the variables loading on the second factor (sexual, biological process, affect and positive emotion words) across the three clusters is of key interest. There was a clear low, to mid to high usage of these variables in men correlating neatly with the low, mid and high scores on the other two factors. The women personals on the other hand do not show such a pattern.

Challenges and Opportunities

Large-scale online surveys present substantial challenges in terms of sampling strategy and response rates. We have worked actively to adapt our approach to both as the study proceeds. In addition to the raffle for $100 gift cards (previously iPod nanos, until we became concerned that “free iPod” sounded too much like spam) described in our original proposal, now we have also arranged for every consenting participant to receive a $5 gift card upon completion of the first questionnaire, which we believe improves initial rates of click-through and willingness to

participate. Furthermore, participants receive additional “raffle tickets” for every questionnaire they complete, an incentive designed to maximize retention over the course of the study.

Also, we have replaced our “pseudo-snowball” sampling strategy with a simpler strategy that we believe will yield a sample with more intact dyads — that is, communicating pairs of online dating users who have both agreed to participate in the study. Instead of expanding the sample based on an analysis of each participant’s contacts on the online dating site (pseudo-snowball sampling), we are now targeting all users in specific geographic regions at once. Since online dating users are generally interested in meeting in person, their contacts are overwhelmingly local. The geographic sampling approach is likely to capture all viable dyads in a region in one pass, avoiding the complexity and delays associated with incremental updates to add new users to the recruitment pool under the pseudo-snowball approach.

Project Title: DHB Collaborative Research: Human Decision Making Dynamics and its Impact on Infrastructure Systems

Proposal Number: 0624361

HSD Emphasis Area: Dynamics of Human Behavior

Lead PI: David Newman, University of Alaska - Fairbanks
Co-PIs: Kara Nance (UAF), Ian Dobson (Univ. of Wisconsin), Matthew Zeidenberg, Ben Carreras (BACV Solutions)

Research Goals:

1. To investigate the dynamics of an integrated system comprised of infrastructure systems such as power networks, communication networks, with a dynamic model of the social interaction with these. This will build on previous work on the complex system dynamics of power transmission networks and of communication networks,
2. To develop a hierarchy of simple models to represent the key human reaction and decision-making dynamics identified in the observations of the real systems, and coupled to models of the complex engineering infrastructure. These models will also allow the investigation of the effects of the topology of human networks on the overall system dynamics.
3. To develop analytical tools to quantify and predict regimes of behavior.

Thematic Areas:

1. Complex system dynamics
2. Agent based decision-making
3. Infrastructure dynamics

Methodologies:

A hierarchy of simple agent based models to represent the key human reaction and decision-making dynamics coupled to a hierarchy of models of complex engineered infrastructure systems is used to investigate the impact of the human interactions with the complex infrastructure systems. This interaction dynamics can then be used to look for feedbacks and vulnerabilities in the coupled systems

Recent Research Findings:

Using a simple dynamic Cascade model representing the operation of an infrastructure system we have begun investigations of the impact of different classes of decision making on the infrastructure dynamics.. The dynamical evolution of the system in the long time scale is governed by a daily increase on consumer demand that raises the overall load on the system and the engineering response to failures that involves the upgrading of the components. The system is controlled through two parameters and two agents who operate the system by selecting those parameters control those two parameters. The utility functions used by the agents to optimize performance incorporate some perception of the events that affect the decision making of the agents. In this preliminary work we look at three social aspects characterizing the agents:

1. Risk averse and risk taking attitudes in the operation of the system.
2. The response to large events triggering a change in behavior on the part of the agents
3. The effect of the learning time in adapting to new conditions.

These three social characteristics have an impact on the performance of the infrastructure system. In moving from risk-taking operation to risk-averse operation there is a reduction in the frequency of failures and in the number of failures per unit time. However, risk aversion brings an increase in the probability of extreme events. During risk-averse operation, the PDF falls off with a lower power than in normal operation. When risk-averse operation is triggered in response to extreme events, we obtain similar results as in the case of continuous risk-averse operation, but

the probability of extreme events can be higher than the continuous operation if this reaction is triggered too often, that is if the threshold for jumping into risk averse operation is relatively low. It is important to note that the results are dependent on the proximity of the system to it's critical point. Our research has suggested that most systems move themselves to be at or near this critical operating point, which is where these somewhat counterintuitive results apply. However if one can operate the system away from the critical point, risk averse operation does in fact reduce the risk of even the large events. Finally, to allow more freedom in exploring the dynamics with the agents, we have successfully coupled the C++ CASCADE model to Repast (an agent modeling framework). This is allowing us to use more sophisticated agents and easily prototype new agents for exploration.

Challenges and Opportunities:

Connecting the next level of our hierarchy of infrastructure models (OPA) with a standard agent system (the Repast agent system) still presents both a challenge (making the coupled system efficient enough to do the needed investigations) and a great opportunity (the flexibility to explore a wider range of agent behavior with an accepted standard agent system). This plus the exploration of the dynamics with these more complicated infrastructure models is our present challenge.

Project Title: Origins and Development of Tribal Social Identities and Territorial Behaviors in Ancient Southern Arabia

Proposal Number: 0624368

HSD Emphasis Area: Dynamics of Human Behavior

Lead PI: Joy McCorriston, The Ohio State University
Co-PIs: Prem Goel and Dorota Brzezinska, The Ohio State University

Project Goals:

1. **To document and explain the long-term social dynamics in the emergence of territorial tribal social groups and their political integration into state societies.** Historical evidence across the Near East—from the earliest written tradition to the Mongols of mediaeval history—suggests that tribal social identity is linked with physical territory and socio- cultural systems, some of which map onto physical terrain. Archaeology offers a unique perspective on tribal dynamics because the perspective is long-term and deals directly with the material culture of tribes-people, rather than the texts that others write about them. This project will document the territorial manifestations of tribal identity within a long time-frame (about 7000 years) [the word through seems to imply the whole of the 7000 years period.] and will explain the dynamics of tribal behavior as affected by major climate and political changes.
2. **To refine the uses of remotely sensed imagery in the analysis of ancient human landscape dynamics.** Although satellite images record a static moment in time and the technologies to do so are ever better, landscapes are dynamic and imbued with social meaning and history that both affects the physical terrain and the ways that societies perceive and interact with it. These histories and human behaviors remain challenging to detect. This research collaboration involving social, physical and statistical scientists will integrate temporal and subjective aspects of landscape in the interpretation of remotely sensed images of the present-day physical terrain and archaeological monuments left by territorial tribes people in antiquity. .

Thematic Areas:

1. Anthropological archaeology, including human behavioral ecology, social theory, culture history, and political economy
2. Spatial statistics and machine learning
3. Geodetic sciences, especially high-precision GPS, remote (aerial) sensing, Digital Elevation Modeling (DEM)
4. Southern Arabia (especially Yemen and Oman)

Methodologies:

The project depends on the interplay of US-based analysis of remotely sensed images of Southern Arabia and the effort of field teams visiting remote areas of the Southern .Arabian deserts to collect archaeological data and GPS coordinates of monuments of interest. We are building on prior knowledge collected both by NSF-funded members of this team over 9 years of fieldwork in Yemen and through collaboration with French archaeologists. We use pilot data to

- Identify high-precision GPS coordinates of locations of small-scale archaeological monuments (“cairns”) on a remote-sensed image.
- Identify signature features/attributes on the image that may possibly characterize these monuments. These monuments were built in antiquity by tribes-people to mark their territories and their social associations with each other and with available resources and terrain. Over the ages, nomadic pastoral people built such monuments in different styles that can be differentiated by shape, height, size, and on the ground, details of construction and associated artifacts. These differences correspond to cultural and temporal differences.

- We expect to use spatial and chronological distributions of monuments as physical markers of ancient tribal territorial behaviors. Spatial and chronological patterns—whether in association with particular land form and resources or distributions of particular "cairn" types—suggest social behavior (territories) and will be interpreted relative to the major political and climate shifts known to take place in prehistory.

Recent Research Findings:
Fieldwork: In 2008, archaeological fieldwork in Yemen yielded excellent ground-based data. The field team collected high quality GPS coordinate data on 475 small-scale archaeological monuments in Hadramawt (exceeding the 3-year expectation by 175 monuments!). These data are the basis for a training and test set to cross-validate the auto-detection algorithm (below). Furthermore the team conducted test excavations at 16 monuments to obtain charcoal and other samples for dating. Eight radiocarbon dates have been returned and we anticipate further dates, including some from experimental research on bone carbonate hydroxylapatite (human skeletons and faunal cuts buried). If confirmed, some of the dates will strongly adjust or expand the expected date range (use range) of certain small-scale monument types. It seems that people used and re-used monuments at different times and possibly for different purposes. Because the majority of monuments were of a type known as High Circular Tomb, further auto-detection will focus on them (HCTs).

Image Processing and Auto-detection: The team has had initial success in developing an auto-detection algorithm to locate monuments in the satellite imagery of Southern Arabia while working on a few training samples manually extracted from larger image polygons. Clusters of pixels may be characterized in a number of ways, including 1) Dark in the Middle, 2) Shadow direction detection compared to what is expected from the image meta data. By averaging the RGB bands in the high-resolution (.6m) pan data-merged with lower resolution (2.4m) RGB and IR spectral bands digitized imagery, an 'intensity' value is returned that serves as the basis for comparison of adjacent pixels and identifying a cluster characteristic of a monument. For each pixel in an image, the goal is to determine whether this pixel is part of an object (monument) or just the background. By looking at a window of pixels around each pixel, it is possible to say whether the pixel is part of a monument, using an image scoring method that relies on intensity. To this early success the team intends to add other features-attributes to the scoring method that will eliminate 'false' monument identifications.

Challenges and Opportunities:
The team has discovered that post-processed data overlay monuments visible on the images with some positional errors, but have managed to improve the positional accuracy to +/- 4 m through geo-rectification using on-demand ortho ASTER DEMs (digital elevation models). The GCPs collected during fieldwork were insufficient for higher accuracy geo-rectification of Quickbird (QB) imagery by building dedicated DEMs of higher resolution. Future fieldwork will emphasize GCP collection at pre-selected locales.

Perhaps most importantly, the success in fieldwork in Yemen has prompted the team to expand spatial data collection to another adjacent region of Southern Arabia, Dhofar (Oman). This region was also impacted by climate and political changes that affected Hadramawt, so with a new data set, we expect to test the models we develop in Hadramawt.

Project Title: What is a "Better" Prediction System? Combining Statistical and Economic Metrics of Prediction Quality

Proposal Number: 0665666

HSD Emphasis Area: Decision Making, Risk, and Uncertainty

Lead PI: A. Small III, The Pennsylvania State University
Co-PIs: J. Evans, K. Keller, A. Kleit, A. Thompson

Project Goals:

- Value of Information in decision making
    a. This is the overall project goal.
- Weather forecast information use in electric load forecast
    a. In the first subproject we examine the problem of an electric utility with respect to weather forecasting
    b. The electric utility desires a forecast that best helps forecasts its load
- Value of model improvements in air quality alert decisions
    a. To diagnose the predictive capability of regional "Air Quality" Forecast (AQF) models, using novel observational approaches.
    b. To develop alternative statistics that measure AQF quality, using economic measures of successful or "missed" forecasts
- Metrics for hurricane forecast value in the issuance of evacuation orders
    a. Development of societal value of information metrics for evaluating the hurricane evacuation orders and the hurricane forecasts which drive them.
- Value of ocean current monitoring networks in climate change decisions
    a. To assess the utility of different potential ocean observation systems to inform the detection and prediction of (as well as decision-making about) potential anthropogenic changes in the North Atlantic Meridianal Overturning Circulation (AMOC).
    b. To test the hypothesis that observation systems that are designed to improve detection capabilities have a different spatial design than observation systems that are designed to improve the economic value of sample information.

Thematic Areas:

- Value of Information in decision making
    a. Decision-making under uncertainty
    b. Economic value of information -- forecasts and predictions
- Weather forecast information use in electric load forecast
    a. Economic value of information.
- Value of model improvements in air quality alert decisions
    a. Anthropogenic climate change
    b. Design of climate observation systems
    c. Decision-making under uncertainty
    d. Economic value of information.
- Metrics for hurricane forecast value in the issuance of evacuation orders
    a. Decision-making under uncertainty
    b. Economic value of information.
- Value of ocean current monitoring networks in climate change decisions
    a. Anthropogenic climate change
    b. Design of climate observation systems
    c. Decision-making under uncertainty
    d. Economic value of information.

Methodologies:

- Value of Information in decision making
    a. Statistical decision theory
    b. Forecast evaluation statistics
    c. Application of mathematical real analysis, measure theory
- Weather forecast information use in electric load forecast
    a. Use autoregressive conditional heteroskedasticity (ARCH) econometric techniques to model load
    b. Using the ARCH parameters, calculate forecast errors from NGM-MOS and ETA-MOS forecasts for the Philadelphia area
- Value of model improvements in air quality alert decisions
    a. Regional coupled dynamic-chemistry modeling
    b. Statistical analysis of atmospheric trace gas and particle data
- Metrics for hurricane forecast value in the issuance of evacuation orders
    a. Construction of databases of the distribution of the Florida population vulnerable to, and hence to be evacuated, hurricane storm surge
    b. Utilization of this vulnerability database for Florida to devise a societally-based metric of hurricane track and intensity forecast skill.
- Value of ocean current monitoring networks in climate change decision
    a. Integrated assessment modeling
    b. Global optimization
    c. Earth system modeling

Recent Research Findings:

- Value of Information in decision making
    a. An explicit mathematical representation of the Value of Information Map had been articulated. The VoI Map is defined entirely in terms of a change in measure on the product space of forecasts and realizations, given a stable set of actions and payoff functions that characterize the decision-maker's problem.
    b. The rigorous definition of the VoI map leads naturally to a conjecture: that the information in the VoI Map is both necessary and sufficient to enable effective communications between producers and consumers of prediction systems around questions of system enhancements.
    c. Statistical analysis of electrical load forecasts produced by a major Independent System Operator of an electric power distribution grid reveals several preliminary findings: that the load forecasts are consistently biased downward; that forecast revisions are auto-correlated, indicating a failure to use all information available in each forecasting period; and that new information arrives most rapidly between the 5-day-ahead and 4-day-ahead forecast announcements.
- Weather forecast information use in electric load forecast
    a. NGM-MOS forecasts are better in the naïve forecasting at 48 hours, ETA-MOS forecasts are slightly better at 24 hours.
    b. Similarly, for load forecasting, NGM-MOS is better at 48 hours, ETA-MOS is slightly better at 24 hours.
- Value of model improvements in air quality alert decisions
    a. When ozone profile observations from balloon-borne instruments were used to evaluate forecast improvements resulting from upgrades to the boundary conditions in the physically based CMAS model (Community Models for Air Quality Systems), free tropospheric ozone predictions were improved but there was little impact on surface ozone forecasts, ie the information value for air quality alerts. This suggests shortcomings in the meteorological or chemical formulation of CMAS that will be investigated with chemical model sensitivity studies.
    b. Using statistics from nighttime ozone profiles collected by Howard University and PSU in summers 2005-2007 to forecast daytime surface ozone, an approach to better predictive skill for this pollutant was developed.

- Metrics for hurricane forecast value in the issuance of evacuation orders
    a. These results should be read in concert with the challenges below. Our key finding is that errors in forecast track and intensity that are accepted as being very accurate compared to long-term forecast errors can result in large over- or under-warned vulnerable coastal populations.
- Value of ocean current monitoring networks in climate change decisions
    a. We have characterized the sensitivity of AMOC hindcasts and projections in the UVic model to key model parameters. As shown in previous studies, the AMOC intensity increases with increasing ocean vertical diffusivity and the AMOC weakens more for a given forcing scenario as the climate sensitivity increases.
    b. We have developed two data assimilation methods that produce posterior parameter estimates that are very broadly consistent. The two methods are so far applied to two different aggregations and sub-sets of the same data-set. We hypothesize that these differences in the aggregations and subsets explain the different parameter probability density functions. We are in the process of comparing the two methods for the same data-sets and applying positive controls (i.e., simulation studies).
    c. Aggregating tracer field can yield an (by us initially unexpected) *tighter* posterior parameter estimate. This suggests that it may be possible to derive an objective and likelihood based relationship between the considered scale and model skill.

Challenges and Opportunities:

- Value of Information in decision making
    a. Showing how the VoI Map structure can be applied in several decision contexts characterized by environmental uncertainty and the availability of imperfect predictive models.
    b. Better modeling of how the electricity load forecasts are used in the generation and dispatch decision contexts.
    c. Linking research methods across disciplinary fields.
    d. Designing scientific studies from a decision-making perspective enables interdisciplinary integration, novel insights and fresh approaches to urgent social challenges.
- Weather forecast information use in electric load forecast
    a. Acquire more load data from PJM for Philadelphia.
    b. Run new GARCH estimates.
    c. Seek out other forecast sources and sources of load data.
    d. Run Monte Carlo simulations
- Value of model improvements in air quality alert decisions
    a. Linking research methods across disciplinary fields.
    b. Designing scientific studies from a decision-making perspective enables novel insights and fresh approaches.
- Metrics for hurricane forecast value in the issuance of evacuation orders
    a. Initially we were informed by the Florida Division of Emergency Management that county-by-county evacuation records were available. However, when we requested these data, they could not be located. We then contacted every county emergency manager and could not get even a single county. As a result, we have had to create a proxy for this database. To do that we have constructed a database of vulnerable populations from evacuation zone maps (which vary by hurricane intensity) and State Department census data. We have then assumed that evacuations were called according to the rules so that the entire population in an evacuation zone for a particular hurricane intensity were evacuated if a storm of that intensity impacted that county.
- Value of ocean current monitoring networks in climate change decisions
    a. Linking research methods across disciplinary fields.
    b. Designing scientific studies from a decision-making perspective enables novel insights and fresh approaches.

Project Title: Solving critical problems in online groups

Proposal Number: 0720286

HSD Emphasis Area: Dynamics of Human Behavior

Lead PI: Robert E. Kraut, Carnegie Mellon University
Co-PIs: John Levine, University of Pittsburgh and John Riedl, University of Minnesota

Project Goals:
Online groups are becoming increasingly important, for example, by creating the software that runs the Internet, building history's largest encyclopedia and providing social support to millions. To be successful all online communities must meet three critical challenges: (1) *Commitment*: gaining and retaining members by managing their commitment to the group and their motivation to exert effort on its behalf, (2) *Coordination*: coordinating members' actions to achieve collective goals, and (3) *Control*: ensuring that members adhere to important group norms. The goals of this project are to:

- Understand the factors that affect the success of online groups in meeting these challenges
- Use the study of online groups to better understand group processes that also apply to offline groups
- Develop technological interventions that can help online groups perform better.

We spent most of year one on the first two of these goals, empirical analyzing factors influencing the success of online communities and emphasizing those that also apply to offline groups.

Methodologies:

- Secondary analysis of archival data about the behavior of individuals in online groups
- Self-report surveys
- Participatory observation
- Technological innovation
- Field experiments

Recent Research Findings:

Coordination in Wikipedia
Wikipedia is the online encyclopedia than anyone can edit. Many attribute the success of Wikipedia and other peer production systems to the large numbers of contributors involved, who provide content, generate new ideas and fix problems. However, many tasks in online peer production communities, including writing articles in Wikipedia, involve high coordination and incur process losses. The primary research goal of this project is to understand the situations in which different coordination mechanisms are most advantageous for effectively harnessing the efforts of an online production group. Because of the availability of archived data and the diversity of coordination techniques used across different articles, Wikipedia provide a unique opportunity for examining how different coordination mechanisms influence quality.

1. We have used a panel design to examine the influence of coordination mechanisms used by the writers of Wikipedia articles during 6-month periods on the changes in quality that occur over the period. Results indicate that, contrary to popular intuition, adding more editors to an article does not always improve quality, but instead depends critically on the type of coordination mechanisms they use. Coordination through direct communication is effective at improving quality early in the life of an article or when there are few editors involved, but coordination through structure and leadership, where few contributors do most of the work, is especially beneficial when many contributors are working on an article (Kittur & Kraut, 2008).

2. Different coordination mechanisms may also lead to different kinds of quality. For example, having many contributors seems to improve coverage, but also leads to fragmented articles. In contrast, having a few contributors doing most of the work seems to improve coherence. We based these conclusions on hand-coding of approximately 8000 peer-reviewers' comments, which are constructive comments made by members of the community, describing ways in which an article could be improved. Peer reviewers find fewer coverage problems when articles have more contributors, but more problems of coherence.

Identifying conflict in Wikipedia
Conflict among the participants in a peer production system such as Wikipedia can affect the amount of work that is accomplished, the willingness of participants to continue working, and the quality of the resulting work-products. We have been developing automated mechanisms to measure and predict the amount of conflict in Wikipedia articles and the factors that predict conflict. We have extracted a set of key features, including characteristics of the state of articles, the state of users and interactions between users, from a database dump of the entire history of Wikipedia. With these features, we are working on making predictions about the probability that a individual revision will be reverted (thrown away) before it is completed and what effect a revert (deletion of an edit) will have on the editor who made it before the reverting took place. We have completed analysis of fundamental measures that allow us to predict when an article is likely to enter a state of conflict and how serious that conflict will be.

Selection and Socialization in Online Groups
One fundamental feature of groups and organizations is that they manage the selection and socialization of new members and, in doing so, significantly affect performance of the group or organization. We've examined socialization in Wikipedia projects and guilds in World of Warcarft (WoW), the most popular US-based multi-player role playing game.

We examined how guilds, the semi-permanent gaming groups in World of Warcarft, and individuals find appropriate matches and whether appropriate matches lead newcomers to stay longer in their guilds. Combining observational, survey and archival data analysis, we found that different selection methods lead to person-guild fit for social and task-oriented guilds, and good fit leads newcomers to stay longer in their guild. In particular, recruitment of new members to task-oriented guilds was most successful when old members had opportunities to interview and play with new recruits, whereas recruitment to social-oriented guilds was most successful when the guilds recruited new members through referrals from current members (Choi, Kraut & Fichman, under review).

We are also investigating how the socialization practices of Wikipedia project groups influence new members' contributions to project-related pages, as well as other indices of their commitment to the project. By examining the project pages for the 50 states in United States, we have identified a range of tactics that Wikipedia project groups use to socialize new members (e.g., welcoming messages both in the form of standardized templates and personalized greetings on the newcomer's page and efforts to encourage more experienced members to respond to newcomers' initial edits). We believe that newcomers' level of prior experience in Wikipedia (i.e., whether or not they have done editing before joining the project group) and the status of the people who contact them after they join (i.e., whether core or peripheral members of the project group) may also be important. We are currently collecting and analyzing data from state projects to assess the impact of these and other socialization tactics on newcomers' behaviors in Wikipedia.

Other research:
In addition to the project just described, we have also conducted research examining how administrators are promoted in Wikipedia and automatically detecting changes in quality in Wikipedia.

Project Title: Collaborative Research: AOC: Reconceptualizing the Genesis of Change in Rural African Societies: Exploratory Research on the Co-Production of Land Use and Livelihood Change

Proposal Number: 0721508

HSD Emphasis Area: Agents of Change

Lead PI: Brent McCusker, West Virginia University
Co-PIs: Edward R. Carr, University of South Carolina; Monica Fisher, Oregon State University/CIFOR; Joseph Hodge, West Virginia University
International Partners: James Chimphamba, University of Malawi, Zomba

Project Goals:

- To re-examine the nexus of land use and livelihood change in order to challenge conventional understandings on the genesis of change, its conditions, and consequences (hypothesized as "co-production" where decisions are made based on rectifying differences between discursive and material understandings of local environment and society).
- To employ a mixed method and inter-disciplinary approach to understand household decision-making and outcomes
- To test the explanatory power and viability of the co-production framework

Thematic Areas:

- Geography
- Agricultural Economics
- History

Methodologies:

- Household /Community Surveys
- GIS/Remote Sensing
- Archival records retrieval

Recent Research Findings:
Preliminary data analysis has pointed to several noteworthy findings that can be reported here, although data collection is on-going.

First, the hypothesis on co-production appears to be verified. Most of our data collection has been focused on determining the presence or absence of co-production in land use and livelihood systems. After initial household surveys indicated that land use and livelihoods were indeed co-produced, PIs McCusker (WVU) and Carr (South Carolina) conducted in depth key informant interviews in May and June and were able to further confirm initial indications. McCusker is processing aerial photographs of the area back to the late 1950s and Hodge is collecting archival data to demonstrate the co-produced nature of the landscape. McCusker plans to conduct one additional round of follow-up in December to finally confirm the hypothesis.

Second, we have observed, with great confidence, the emergence of a local level food crisis on the west side of Mt. Mulanje. We are continuing to investigate this through December, but anticipate one of the higher value outcomes of the project will be a report on this localized food insecurity. We will be conducting a detailed food security survey in December to verify our initial findings.

Third, we are growing convinced of the need in future research to examine the twin impacts of climate change and rising global food prices. Severe pressures are readily observable in the research areas, especially concerning the latter. Given the incredible land pressure and growing

erratic nature of rainfall, we are also convinced that adaptation strategies to climate change should be examined. Land pressure in the area limits extensive strategies for coping with climate change induced rainfall shifts. Early indications are that villager adaptation strategies are shallow, at best, and that out-migration is a key, and early, coping strategy.

Challenges and Opportunities:
Opportunities: The Office of International Science and Engineering at NSF provided us with the opportunity to take two undergraduate students with us for field research by providing an additional $10,000 to the grant. We expanded this opportunity by securing $16,000from West Virginia University's Eberly College of Arts and Science. The project has provided innumerable opportunities for each of the PIs and the project participants to enhance their research and teaching skills. The multi-disciplinary nature of the project has substantially enhanced the research techniques of each of the other PIs. We have two geographers, an agricultural economist and an historian among the four PIs. Research methods range from the highly quantitative, to the highly qualitative to archival. The four PIs have interacted very closely and have benefitted from the cross-fertilization. The group met for two days in October in the US to plan the grant, McCusker and Fisher worked together in Malawi in January, Carr and McCusker worked together in May, and Hodge and McCusker worked together in June. In each of these experiences, the lead researcher in the field had to administer the research methods of the other groups. For instance, Fisher had to conduct geographic work in February, and McCusker and Carr conducted historical and economic research in May. This experience had greatly broadened the research skills of all involved.

The unique opportunity of engaging undergraduate students in the field has greatly enhanced the teaching skills of McCusker, Carr and Hodge. Students present opportunities and challenges for teaching and learning in a classroom setting that are drastically different from those they present in a field research setting (add to this, the fact that our field setting was in a developing country in Africa). Teaching became a continuous event, especially given the fact that the PIs were in the same lodging as the students. We had to quickly learn not only how to teach about the research we were conducting but how to do so when the cultural context in which the students were learning were so very different from what they were accustomed to (e.g. frequent and long power outages, lack of internet, lack of transportation, etc.).

Challenges: We faced no major unexpected challenges. Traveling to underdeveloped countries in itself is a major challenge, yet we expected this.

Project Title: DRU Decision Support Systems and Multi-Stakeholder Environmental Problem Solving: Effects on Public Participation, Equity and Power

Proposal Number: 0722145

HSD Emphasis Area: Decision Making, Risk, and Uncertainty

Lead PI: Eric T. Jones, Institute for Culture and Ecology
Co-PIs: Rebecca McLain, Institute for Culture and Ecology; Gregory Hill, University of Portland; Steven Kolmes, University of Portland.

Project Goals:
Our goal in this Exploratory Research project is to gain an understanding of how the use of decision support systems (DSS) in multi-stakeholder environmental problem solving processes affects the breadth of public participation, quality of public participation, equity among participating stakeholders and quality of outcome.

Thematic Areas:
- Environmental anthropology
- Policy analysis
- Knowledge quality assessment

Methodologies:
We are pursuing a mixed-method study combining:
- Rapid ethnographic assessment
- Content analysis
- Survey and associated statistical methods

Recent Research Findings:

Preliminary results from rapid ethnographic assessment:
Knowledge quality assessment: During the rapid ethnographic assessment we have completed 78 formal interviews, 23 informal interviews, and substantial participant observation during three months of intensive fieldwork throughout Columbia River basin watersheds. The formal interview subjects have ranged from agency managers and scientists to local stakeholders and fieldwork sites have ranged from urban settings to rural communities in Oregon, Washington and Idaho. An understanding is emerging of the process by which scientific information is assembled by local participants in planning processes and eventually transmitted to decision-makers in state and federal agencies. A critical element in this process is the role played by uncertainty: how uncertainty is assessed by the parties developing scientific knowledge, how uncertainty and risk are communicated through a complex planning process, and how uncertainty is perceived by stakeholders and decision makers. A preliminary conclusion of our research is that a system of knowledge quality assessment is needed to ensure that the uncertainties associated with scientific data, ranging from model outputs to oral history, is evaluated and communicated according to transparent standards. Based on these preliminary findings we have been invited to contribute a paper and talk at the conference “Transboundary River Governance in the Face of Uncertainty” sponsored by the University of Idaho College of Law, Oregon State University, Washington State University, University of Montana, and University of British Columbia. The conference is intended to contribute to the renegotiation process for the international Columbia River Treaty between the United States and Canada governing use of the river resource.

Equity and breadth of participation. Throughout the rapid ethnographic assessment we have been evaluating factors affecting the breadth of public participation and equity among stakeholders, especially in regards the use of technological planning tools such as the Ecosystem Diagnostic and Treatment (EDT) modeling software used extensively in Columbia River basin salmon recovery planning. Expertise and facility in the use of these tools appears to play an important

role in determining which potential participants actually take part in the planning process (or drop out) and to influence which participants are able to make significant contributions to planning outcomes. During fieldwork we have become aware of many "missing stakeholder" groups who are either unaware of the planning process, are invited but decline to participate, or who leave the process. For example, a number of environmental stakeholders have dropped out of basin planning only to reenter by bringing suit to against agencies in federal courts. These findings indicate that the federal court system must be regarded as an integral element of the planning process itself and not simply as an arbiter of final planning outcomes.

Framing and decision support systems. Based on data from ethnographic interviews we have identified a potential systemic effect of the extensive use of modeling in the planning process for salmon recovery in the Columbia River basin. We posit a "forecasting frame" that modeling imposes on planning. This frame privileges the "business as usual" scenario, locating perceptions of risk for other scenarios according to their perceived distance from "business as usual". We distinguish this frame from a "backcasting frame" in which scenarios are developed by working backwards from envisioned future states of the world. Several interview subjects have exhibited this latter approach to scenario development and have expressed frustration with the planning process. A refereed conference paper "*Aspirational Goals and Incremental Tools: Does Forecasting Exclude Other Frameworks for Strategic Planning?*" was delivered at an international conference, "Tools for Participation: Collaboration, Deliberation and Decision Support", held at University of California, Berkeley in June, 2008 and sponsored by Computer Professionals for Social Responsibility and UC Berkeley School of Information.

Preliminary results from content analysis of planning documents:
Factors affecting plan quality: We conducted a content analysis of the independent scientific reviews of the 46 Columbia River subbasin plans to identify key factors likely to have affected plan quality. Factors most commonly mentioned as affecting plan quality (other than inadequate funding and time, which applied to all of the subbasins) included 1) the capacity of the subbasin planners to use the two commonly used decision support tools, EDT and another, Quality Habitat Assessment (QHA), 2) extent to which data relevant to salmon recovery already existed for the subbasin, 3) degree to which the planning process involved a broad range of stakeholders, 4) extent to which subbasin planners collaborated with provincial and regional planning entities in plan development, and 5) extent to which strong conflicts existed between subbasin stakeholders over land and water resource use. Factors 1 - 4 were positively associated with plan quality while factor 5 was negatively associated with plan quality. Results from this analysis fed into the development of an article examining the relationship between planning capacity and the use of decision support systems in the subbasin planning process. The results were also used in the formulation of the interview protocol used in the rapid ethnographic assessment.

Creating shared mental models through subbasin planning and the use of decision support systems: Based on the above content analysis and a review of the subbasin plans, we examined the role that subbasin planning involving the use of decision support systems played in fostering a shared mental model of ecosystem management among diverse stakeholder groups in the Columbia River basin. Our analysis indicates that the planning process expanded the region's ecosystem management capacity in two ways. First, it brought together planning entities that previously acted independently, fostering the expansion of planning networks within and across subbasins. Second, to facilitate the subbasin planning process, the Northwest Power Planning Council created several centralized repositories of scientific data located on publicly accessible websites, greatly expanding the region's capacity to develop and share knowledge about ecosystem conditions. However, the analysis indicates that only a narrow selection of stakeholders (generally state and tribal fish and wildlife agency employees) were involved in the use of the decision support tools, and that the use of such tools played a limited role in the formation of shared mental models among the broader set of stakeholders involved in subbasin planning. The results from this analysis suggest that there is an on-going need for integrating more participatory forms of decision support tools into river basin management. A peer review

journal article, *Adaptive ecosystem management in a post-normal science context,* based on this analysis is in preparation.

Challenges and Opportunities:
The rapid ethnographic assessment has revealed significant differences in the planning context from what we were able to discover from publicly available documents used to develop the experimental design. The most significant difference is the relative lack of diversity in the types of decision support systems used in the planning units. One decision support system (DSS), EDT, plays a dominant role. Some planning units have used altered versions of EDT, some have opted out from using any DSS and other types of DSS are in use in closely related planning processes. This situation will limit our ability to answer some of our initial questions using statistical analysis. We are adapting our upcoming survey instrument based on this understanding, derived from the ethnographic phase of the study. Although our ability to compare statistically the effect of a wide range of DSS systems on public participation processes is somewhat diminished, we have been very pleased by the abundance and quality of data coming out of the ethnographic work as evidenced by invitations to contribute papers to high-level conferences. Based on this preliminary work we are developing the capacity for our research to have significant impacts for the understanding and practice of public participation in environmental planning.

Project Title: Visualizing culture-gene influences on neural systems of emotion

Proposal Number: 0722326

HSD Emphasis Area: Dynamics of Human Behavior

Lead PI: Dr. Joan Y. Chiao, Northwestern University
Co-PIs: Dr. Ahmad R. Hariri, University of Pittsburgh; Dr. Tetsuya Iidaka, Nagoya University
International Partner: National Institute for Physiological Sciences, Okazaki, Japan, MRI facility

Project Goals:

- To examine how cultural environment affects expression of the 5-HTTLPR serotonin transporter gene on amygdala response to emotional scenes, by comparing genetic, neuroimaging and self-report behavioral data from Native Japanese and Caucasian-American cohorts;
- To determine how dynamic cultural processes, such as acculturation, affect genetic expression of 5-HTTLPR on amygdala response to emotional scenes, by comparing Native Japanese and Caucasian-American cohorts with a separate cohort of Japanese-Americans, using behavioral, neuroimaging and genotyping measures.

Thematic Areas:

- Cultural, social and affective neuroscience
- Imaging genetics
- Cultural psychology
- Cross-cultural psychiatry

Methodologies:

- Functional magnetic resonance imaging of the brain
- Genotyping
- Behavioral surveys

Recent Research Findings:
This one-year exploratory grant from the NSF Human and Social Dynamics Program: Dynamics of Human Behavior track, awarded on September 1, 2007, supported the implementation of a cross-cultural neuroimaging study of emotion.

In this study, we measured neural response within the amygdala and ventrolateral prefrontal cortex emotional and non-emotional stimuli in Caucasian-American (N = 11), Japanese-American (N = 10) and native Japanese (N = 9) cohorts. Data collection for Caucasian-American and Japanese-Americans was conducted at the Northwestern Center for Advanced Medical Imaging (NU CAMRI) and data collection for native Japanese was conducted at the Okazaki National Institute for Physiological Sciences (Okazaki NIPS). All participants completed experimental tasks and measures that were administered in their native language by a team of researchers from their own culture.

We found robust evidence for cross-cultural variation in bilateral amygdala response to emotional scenes. Native Japanese showed greater bilateral amygdala response to negative emotional stimuli relative to Caucasian-Americans and Japanese-Americans. Moreover, this cultural variation in amygdala response was not observed when participants completed a non-emotional task, such as inhibiting a cognitive response. These novel neuroimaging results show that cultural environment exerts a significant influence on amygdala response to emotional information, even when controlling for known genetic factors, such as population frequency of s allele carriers of the 5-HTTLPR, which may lead to cultural variation in neural response.

Challenges and Opportunities:
A major challenge in implementing this project was developing technology to measure and control for potential MRI signal variation across scanner sites. More specifically, a possible alternative explanation of the current finding described above is that cultural variation in amygdala response to emotional scenes is due to variation in scanner site, not cultural environment *per se*. However, there are at least three reasons why this alternative explanation is not plausible.

First, there are a number of peer-reviewed published neuroimaging studies already demonstrating the viability of analyzing fMRI data collected from multicenter fMRI sites (Friedman and Glover, 2006). These prior neuroimaging studies have demonstrated that interscanner variability from two or more scanner sites using identical vendor's instrumentation and parameters is negligible (Friedman and Glover, 2006). Given that functional neuroimaging data was collected from the two scanner sites (NU CAMRI and Okazaki NIPS) using nearly identical vendor's instrumentation and imaging parameters, potential interscanner variability is negligible.

Second, in the cognitive inhibition task, there was no significant group difference in VLPFC during inhibition. If scanner site introduced potential variation in MR signal, this variation would presumably be observed within the same participants in other experimental tasks and/or brain regions. Given that no cultural group variation was observed in the Inhibition task, it is unlikely that cultural variation observed in amygdala response to emotional scenes was a result of MRI signal differences across scanner sites.

Third, we also independently verified scanner site reliability by comparing functional data from a separate cohort of 6 individuals (2 female, 4 males) who were scanned at both NU CAMRI and Okazaki NIPS MRI facilities on the identical emotional scene matching task within 6 months time. Previous scanner variability studies have also involved a small sample size of subjects tested at each site on the same functional task (Friedman and Glover, 2006). Following standard methods for establishing cross-site scanner reliability, results from signal-to-noise ratio (SNR) analysis indicated no significant difference in SNR within bilateral amygdala region across scanner sites, t (5) = 0.96, p = 0.38 (Parrish et al., 2000). Additionally, intraclass correlation coefficient indicated high interscanner reliability between the Okazaki and NU FMRI facilities (ICC = 0.65). We also examined % signal change within the identical bilateral amygdala region during the emotional scene matching paradigm and found no significant difference in % signal change across the two scanner sites, t (5) = 1.12, p = 0.31 (see Figure 1b).

Hence, we were able to successfully design an experimental measure to ensure that there does not exist significant variability in scanner performance between the two scanner facilities within the bilateral amygdala region.

Project Title: A Multi-Disciplinary Approach to Communicating Weather Forecast Uncertainty

Proposal Number: 0724721

HSD Emphasis Area: Decision Making, Risk, and Uncertainty

Lead PI: Susan Joslyn, University of Washington
Co-PIs: Tilmann Gneiting, Adrian Raftery, David Jones and Cliff Mass, University of Washington

Project Goals:

- To bridge the communication gap between the creators of weather forecast uncertainty information and the end-user.
- To define the psychological principles that govern successful communication of forecast uncertainty in terms of end-user understanding and improved decision making.
- To create useful and effective uncertainty products for the general public and make them available on the World Wide Web.

Thematic Areas:

- Psychology
- Statistics
- Atmospheric Sciences
- Applied Physics

Methodologies:

We take an interdisciplinary approach to determining the most useful and informative means for communicating weather forecast uncertainty to non-expert end-users. We conduct psychological studies, informed by statistical and meteorological analyses, to test expressions that are both understandable and theoretically accurate. For instance we have selected the median value as the deterministic temperature forecast because it has the following simple definition: It is the temperature that will on average be the closest to the observed value (in terms of minimum absolute error). That allows us to use verification based on absolute error, appropriate for situations in which both positive and negative errors are weighted equally, and lays the groundwork for comprehensible verification displays. At the same time the statistical and meteorological efforts are focused on areas that have been identified by psychological studies as the most relevant to everyday users.

Psychology methods

- Surveys to probe issues using multiple specific questions that avoid bias.
- Talk-aloud verbal protocols to capture on-line thought processes.
- Experimental studies, systematically manipulating the presentation format
    a. In which participants read about a scenario and make a decision that requires interpreting contextually imbedded uncertainty information.
    b. In which participants make weather-related decisions based on a simulated task in a virtual environment, are informed of the outcome of each decision and are rewarded monetarily for successful decision-making.

Statistics & Meteorology

- Probabilistic forecasts are produced using ensembles and Bayesian model averaging (BMA). New methods have been developed that can handle missing member forecasts as well as methods that simplify the BMA model and speed up the necessary computations when there are exchangeable members. The latter technique is justified because some ensemble members are multiple forecasts arising from the same process but subject to random variation. This allows us to combine different types of ensembles in current use.

- We are developing a new version of BMA that estimates values for locations where there are no observations using *any* observations of that event (e.g. snow) but giving closer locations more weight. This allows for forecasts of extreme events (e.g. high precipitation, snow in the low lands, high winds, and very high or very low temperatures) at locations anywhere over a spatial field.

- We will develop diagnostic graphics and proper scoring rules for verification, which avoid hedging and allow for a meaningful assessment of probabilistic forecasts of extreme events.

Recent Research Findings:

Psychology and Usability:

- We collected a catalogue of typical decisions for which the general public and two special interest groups (recreational boaters and wine grape growers) need weather forecast uncertainty information.
- We found that wind forecasts are a primary need of both recreational boaters and wine grape growers so we focused our efforts on the development of probabilistic forecasts for that parameter.
- We learned that non-expert users have varying probability thresholds by which their actions are guided, suggesting that they can make use of explicit uncertainty information.
- We learned that users add wide error bars to existing deterministic forecasts, that they trust extreme values least and adjust extreme forecasts systematically toward more moderate values. These results suggest that calibrated and sharp probabilistic forecasts will provide more precise and accurate information than the wide range of values and the primitive bias correction currently employed by non-expert end users.
- The results of studies comparing partial (worst case scenario) to full uncertainty information suggest that the former, although reducing the amount of information to be processed, leads to biased understanding and decision-making.
- The results of studies investigating probability of precipitation forecasts demonstrated that expressions including the uncertainty associated with both possible outcomes (chance of rain and no rain) reduce common errors in interpretation.
- Preliminary results from the simulation study (repeated decisions with feedback and monetary rewards) suggest that uncertainty information improves decision-making in a realistic weather-related decision task. Furthermore, people request uncertainty information when it is not provided with the initial forecast suggesting that they are aware of its value.

Statistics and Atmospheric Science:

- We developed statistical post-processing methods for wind speed including extreme winds, wind vectors, and for wind speed and direction jointly. We have two complementary approaches for doing this, one based on Bayesian model averaging and another based on heterogeneous Gaussian regression.
- We developed a novel test for equal predictive performance of density forecasts that allows the assessor to focus on a range of particular interest, such as extreme wind speeds, and is based on proper scoring rules.
- We created diagnostic tools for the assessment of calibration and sharpness and completed the development of a probabilistic forecasting method for decisions about pre-treating mountain highways for ice and snow.
- We completed a software package for probabilistic forecasting, ensembleBMA, with accompanying documentation including a user's manual, and issued it as an R package on the Comprehensive R Archive Network (CRAN http://www.cran.org).

Challenges and Opportunities:

- We will add new parameters (initially wind speed) and warning forecasts (e.g. high winds) to our existing website (PROBCAST). In addition, we will provide verification graphics, after testing the psychological implications of various presentation formats. Organizing this information in a simple and comprehensible manner will be challenging.
- We are also working on novel, theoretically principled methods for the evaluation of probabilistic forecasts and for comparing the forecasts resulting from our methods to existing forecasts.
- We will continue to develop our user groups to test the impact of various forms of uncertainty information on decision-making, especially as this information pertains to warning forecasts (extreme values) and verification.

Project Title: Anthropological modeling of social structure, genetics and language speciation in Indonesia

Proposal Number: 0725470

HSD Emphasis Area: Agents of Change

Lead PI: J. Stephen Lansing, University of Arizona
Co-PIs: Michael Hammer, Tatiana Karafet, Joseph Watkins. University of Arizona
Collaborators: Eijkman Institute for Molecular Biology, Ministry of Public Health, National Language Institute, Indonesia

Research Goals:
The Indonesian archipelago encompasses great cultural, genetic and linguistic diversity, from patrilocal wet-rice farmers in Java and Bali to matrilocal communities in the mountains of Flores, and hunter-gatherers in the forests of Borneo and West Papua. Taking advantage of this broad diversity, this project's research goal is to build and test anthropological models to explain observed patterns of genetic and linguistic variation at the levels at which they originate.

Thematic Areas:
Until now, most studies of genetic and linguistic evolution and differentiation have focused on large-scale regional or continental patterns, characterized from a phylogenetic perspective. Yet all such patterns arise from processes that begin at the community level. Our approach is to gather information at the community level to address community based, island based and region based questions.

Methodologies:
In collaboration with Indonesian researchers and public health teams, our research team has been collecting genetic, linguistic, demographic, environmental, medical and ethnographic data from villages throughout the archipelago.

A combination of modeling and inferential approaches is necessary to investigate the processes under study. Thus, we are developing our own genetic and linguistic models appropriate for the spatiotemporal scales under study, designing inferential and simulation strategies, creating software to implement the models and to make inference, and working with developers to extend their own highly regarded software packages.

Recent Research Findings:
Selection and the neutral theory. A central tenet of evolutionary social science holds that behaviors, such as those associated with social dominance, produce fitness effects that are subject to cultural selection. However, evidence for such selection is inconclusive because it is based on short-term statistical associations between behavior and fertility. The evolutionary effects of dominance at the population level can be detected using noncoding regions of DNA. Highly variable polymorphisms on the non-recombining portion of the Y chromosome can be used to trace lines of descent from a common male ancestor. Thus it is possible to test for the persistence of differential fertility among patrilines. We examine haplotype distributions defined by 12 Y-chromosome short tandem repeats in a sample of 1269 men from 41 Indonesian communities, and test for departures from neutral mutation-drift equilibrium based on the Ewens sampling formula. Our tests reject the neutral model in only five communities. Analysis and simulations show that we have sufficient power to detect such departures under varying demographic conditions including founder effects, bottlenecks and migration, and at varying levels of social dominance. We conclude that patrilines are seldom dominant for more than a few generations, and thus traits or behaviors that are strictly paternally inherited are unlikely to be under strong cultural selection.

Our findings appeared in the *Proceedings of the National Academy of Science*, a revision of the

mathematical issues associated to this project are under review for the *Journal of Mathematical Biology,* and an overview has been prepared for *Current Anthropology* and is in review.

Gene Language co-evolution at the community scale. Numerous studies indicate strong associations between languages and genes among human populations at the global scale, but all broader scale genetic and linguistic patterns must arise from processes originating at the community level. We examined linguistic and genetic variation in a contact zone on the eastern Indonesian island of Sumba, where Neolithic Austronesian farming communities settled and began interacting with aboriginal foraging societies 3,500 years ago. We discovered clear patterns of language–gene geography correlations, unprecedented at such a fine scale, which imply that historical patterns of social interaction between expanding farmers and resident hunter gatherers largely explain community level language evolution on Sumba. We proposed a model to explain linguistic and demographic coevolution at these fine spatial and temporal scales.

We are presently examining this model on other islands, beginning with Flores.
While the details of the peopling of these islands will have a distinctive history, the basic model appears to hold firm for Flores.

Challenges and Opportunities:

- We are expanding both our genetic and linguistic database as a strategy to provide new evidence on the contentious questions of Austronesian and Indonesian origins.
- We are currently working with Family Tree DNA to parameterize our model for microsatellite evolution. This will be used to enhance BATWING, a frequently used genetics software tool. This will be used to develop more accurate dating of significant historical events for the Indonesian archipelago.
- We are extending our fieldwork in Indonesia and intensifying our collaboration with the Eijkman Institute.
- We are conducting a survey for the B3D27 (SLC4A1 gene) among several populations to determine whether the frequencies of disease resistance markers, which reflect natural selection, correlate with frequencies of neutral genes, which represent demographic history.
- We are examining admixture across the Indo-Pacific region through autosomal and X-chromosome SNPs.
- Thanks to supplementary support from a second NSF grant, we are working with Dr. André Singer on an educational video. A rough cut is available is available as streaming video at http://www.ic.arizona.edu/~lansing/Austronesia/Welcome.html
- We have has been assisting the Indonesian government (Director Generals of Antiquities and Culture) in the creation of UNESCO World Heritage cultural landscape program in Indonesia, including Bali, Nias and Toraja.

Proposal Title: Collaborative Research: Interactive Deception and its Detection Through Multimodal Analysis

Project Number: 0725607

HSD Area of Emphasis: Dynamics of Human Behavior

Co-PI: Dimitris Metaxas, Department of Computer Science, Rutgers University

Through the proposed collaborative research program with the University of Arizona (Dr Burgoon) and the Univ. of Chicago (Dr. McNeal) we will examine deception as an interactive, adaptive, and multimodal social phenomenon.

The specific objectives of the proposed research related to the Rutgers effort as are follows:
1) ***Apply human tracking and statistical analyses and data mining techniques*** to:
   a. test for specific patterns of adaptation between deceivers and deceived at interaction turning points,
   b. uncover heretofore unrecognized patterns, and
   c. assess improvements in predictive accuracy that can be achieved by augmenting or substituting human-annotated verbal and nonverbal behaviors with automated analysis.
2. ***Develop tools for automated multimodal analysis of deception***. Based on the preceding results, linguistic analysis tools will be fused with acoustic analysis tools and computer vision techniques to advance automated multimodal detection systems. The development and integration of automated tools, could result in breakthroughs in this area.

The team is headed by the Center for the Management of Information at the University of Arizona (UA), which is an NSF Industry/University Cooperative Research Center. Collaborating U.S. teams are the University of Chicago (UC), Rutgers University (RU) Center for Computational Biomedicine, Imaging and Modeling (CBIM), Michigan State University (MSU), and University of Pittsburgh (UP). International collaborators include the University of Iceland (UI), University of Cologne, Germany (UIG), and Imperial College London (ICL).

During the first year of our grant we have focused on the following:

"Our video analysis uses two separate programs to track facial features and detect certain gestures. The ASM tracker is able to accurately localize and track 79 facial feature points describing the head's contour and the outline of its constituent parts, i.e. nose, eyes, eyebrows and mouth. While doing so, the program records the (x,y) coordinates of each feature point, detects head shakes and head nods by monitoring changes in the position of the nose tip, and estimates the 3D pose of the head described by the pitch, yaw and tilt angles. The ASM tracker can also detect shoulder shrugs (to a user defined level of
sensitivity) and open and closed mouth status. The blob tracker detects and tracks skin blobs, i.e. head, left palm, right palm, and records the (x, y) coordinates and area (in pixels) of each blob.

We are currently developing an improved blinking detection algorithm. The initial blinking detection algorithm did not require the offline step of extracting the appearance template for the closed eye and used only the appearance template learned online for the open eye. However, this required the user to define similarity/dissimilarity thresholds to differentiate the two states. Our new algorithm uses two appearance templates for the subject's eyes, one for each of their two possible states (opened and closed). The template for the closed eye appearance can be easily extracted offline and fed as input to the program. The template for the open eye appearance is learned online automatically by focusing on the region of the eyes and assuming that in the first few frames, a subject's eyes are open and accurately tracked. Both templates are essentially a statistical model of the color distribution of the eye in each of the two states. At each frame the program extracts the eye regions and builds a statistical distribution of their

appearance. These are then passed onto the classifier which picks the state whose appearance template is most similar to the current appearance of the eyes."

Resulting Publications and Books

1) Rosenhahn B., Klette R. and Metaxas D. (Editors) Human Motion - Understanding, Modelling, Capture and Animation *Computational Imaging and Vision*, Vol. 36, Springer Verlag, ISBN: 978-1-4020-6693-1
2) Zhiguo Li, Qingshan Liu, Dimitris N. Metaxas: Face Mis-alignment Analysis by Multiple-Instance Subspace. ACCV (2) 2007: 901-910
3) Qingshan Liu, Dimitris N. Metaxas: A Unified Framework of Subspace and Distance Metric Learning for Face Recognition. AMFG 2007: 250-260
4) Peng Yang, Qingshan Liu, Dimitris N. Metaxas: Boosting Coded Dynamic Features for Facial Action Units and Facial Expression Recognition. CVPR 2007
5) Gabriel Tsechpenakis, Dimitris N. Metaxas: CRF-driven Implicit Deformable Model. CVPR 2007
6) Atul Kanaujia, Cristian Sminchisescu, Dimitris N. Metaxas: Semi-supervised Hierarchical Models for 3D Human Pose Reconstruction. CVPR 2007
7) Atul Kanaujia, Dimitris N. Metaxas: Large Scale Learning of Active Shape Models. ICIP (1) 2007: 265-268

Project Title: Collaborative Research: Interactive Deception and its Detection through Multimodal Analysis of Interviewer Interviewee Dynamics

Proposal Number: 0725895

HSD Emphasis Area: Dynamics of Human Behavior

Lead PI: Judee K. Burgoon, University of Arizona
Co-PI: Jay Nunamaker, University of Arizona
Collaborating U.S. Partners: David McNeill, University of Chicago; Susan Duncan, University of Chicago; Dimitris Metaxas, Rutgers University; Timothy Levine, Michigan State University; Hee-Sun Park, Michigan State University; Frank Biocca, Michigan State University; Jeffrey Cohn, University of Pittsburgh
International Partners: Magnus S. Magnusson, University of Iceland; Gary Bente, University of Cologne Germany; Anil Bharath, Imperial College London; Enrica Dente, Imperial College London

Project Goals:

- Develop a theoretical model that shifts emphasis from the individual to the dynamic adaptations that characterize interpersonal deception
- Develop as test beds six high quality corpora and annotate their verbal and nonverbal features through extensive automated and manual measurement of text, audio and visual modalities
- Conduct theory-driven hypothesis tests and exploratory tests using time-series, Bayesian-based Theme analyses, and artificial intelligence data mining techniques to identify dynamic adaption patterns
- Develop and validate tools for objective, automated multimodal measurement of deception
- Advance the scientific infrastructure for studying deception through creation of the largest international and multidisciplinary research team of deception experts of its kind

Thematic Areas:

- Individual and cultural variability in truthful and deceptive communication
- Co-verbal gestures during truthful and deceptive communication
- Computer-mediated communication and deceptive displays
- Deception in group decision making
- High stakes deception including mock crime and unsanctioned lies
- Effects of suspicion on exhibited dominance during deception

Methodologies:

- Experimental studies including observation, interviews, video recording, multi-sensor recording, and survey instruments
- Technology-enabled observation for the automated coding of verbal and nonverbal behavior
- Annotation of speech, gesture, and nonverbal behavior
- Transcription and linguistic content analysis
- Statistical and machine learning methods

Recent Research Findings:

The University of Arizona completed the Cultural Gestures pilot experiment with a sample size N = 69. Of these subjects, 43.5% were from China and 78.9% indicated English was not their first language. Subjects were videotaped while being instructed to lie or tell the truth in English, and their native language. Transcription and analysis methods for comparing interview responses in multiple languages were developed. The video tapes of the Cultural Gestures pilot subjects were

digitized for automated nonverbal kinesic and proxemic coding. These digitized videos were used to generate x and y coordinates of face and arms for each video frame using blob tracking.

Experimental procedure and instrument validation resulting from the Cultural Gestures pilot will be incorporated into subsequent culture and deception studies. Following the Cultural Gestures pilot, a literature review was conducted resulting in a definition and measurement of culture. These measurements were incorporated into the current Cultural Benchmarks deception study (sample size N = 219) for which data collection recently closed, and analysis is ongoing. Interviews from this study are being transcribed for automated text feature extraction. A preliminary analysis (N = 47) of the transcribed subjects led to the development of a classification model with an 88% accuracy in detecting deception.

Michigan State University completed collection of data on the MSU cheating experiment during the first year. Data from 107 subjects were collected. The target sample size was N = 100. All the videotaped interviews were digitized and, once digitized, transcribed.

The University of Chicago has received approximately four-fifths of the audio-video and transcript data for the 10% of each corpus targeted for Year One annotation and analysis efforts. As they receive the text data they will import them, with careful correction for accuracy, into ELAN, together with the associated audio-video data. This is the first step in the developed process, so far in Year One, of accumulating annotations on behaviors relevant to truthful and deceptive communication.

Also during Year One, the University of Chicago has acquired competence in the use of Theme™. This software automatically analyzes any number of annotated, time-anchored, behavioral streams for repeating occurrences of sequential patterns of behaviors. It finds patterns within an individual participating in an interaction, or between individuals at the level of the dyad. When sufficient data from each corpus is annotated, they will employ Theme™ to look for, for example, sequences of behaviors on the part of a speaker that typify intervals of deception, and listener reactions, if any, to such sequences.

Finally, Chicago Gesture Lab members are leveraging an ongoing collaborative partnership with researchers at MITRE Corporation that concerns development of interoperability standards for software tools that different research groups use to annotate and analyze multimodal communication data. The Gesture Lab is among the first to exploit this development work. They are formatting files of annotation data accumulated using ELAN to make the annotation data suitable for input (via a software-enabled procedure developed in 2007) into Theme™ for analysis of sequential patterning.

The first planned phase of the University of Chicago's contribution to the larger collaboration will conclude in late fall of this calendar year with comprehensive Theme™ analyses of the first 10% portion of each of the five deceptive communication corpora. The results of these analyses will show where their annotative procedures may need modification or reconceptualization, as they advance thereafter to processing the remainder of each corpus.

Challenges and Opportunities:
Annotation and coding of observed verbal and nonverbal behavior is very time intensive, requiring teams of coders to ensure reliability. This reinforces the need for objective, and automated technology for coding verbal and nonverbal behavior. This technology is currently being researched in this project in the form of Automated Text Feature Extraction, Automated Acoustic Feature Extraction, and Automated Nonverbal (Kinesic and Proxemic) Coding.

Project Title: DHB Collaborative: Lifespan Dynamics of Cognition & Action

Proposal Number: 0728743

HSD Emphasis Area: Dynamics of Human Behavior

Lead PI: Guy Van Orden, University of Cincinnati
Co-PIs: Michael Riley, Kevin Shockley, and Heidi Kloos, University of Cincinnati; Joseph Zbilut, Rush University Medical Center; Lawrence Gottlob, University of Kentucky

Project Goals:

- Identify reciprocal influences of cognition and motor control in the dynamics of each behavior
- Track developmental changes in the control & coordination of cognitive & motor dynamics
- Develop recurrence quantification analysis as a method for characterizing fractal variability in short, noisy, and nonstationary time series

Thematic Areas:

- Complexity & dynamics in cognitive science
- Human development
- Fractals
- 1/f (pink) noise
- Nonlinear time series analysis

Methodologies:

- Experimental psychology involving human subjects research
- Nonlinear time series analysis (detrended fluctuation analysis, recurrence quantification analysis)

Recent Research Findings:
When children perform cognitive and motor tasks they typically exhibit more variability than adults. The difference in performance variability becomes smaller over time, however, and adolescents resemble adults in terms of the amount of performance variability they exhibit. Variability of performance is thus an important way of indexing developmental changes in cognitive and motor performance. Equally important are the dynamics of cognitive and motor performance—the manner in which the behavior unfolds over time. Such dynamics reveal themselves in the structure of performance variability. Many cognitive and motor tasks exhibit a particular type of dynamical structure, a fractal pattern of variability termed 1/f or pink noise (Gilden, 2001; Hausdorff et al., 1996; Van Orden et al., 2003, 2005). In 1/f noise, which is a hallmark signature of complexity, the patterns of performance variation found at one time scale are similar to those found at other scales, and the variations in performance are characterized by the presence of long-range correlations. For cognitive and motor tasks characterized by 1/f noise, performance variability is thus not random, but instead possesses an inherent dynamical structure.

Quantifying the dynamical structure of behavioral variability promises to reveal new insights into the underlying processes of coordination in human performance. An example comes from an earlier study from our laboratory (Kiefer et al., in press). Adults performed a cognitive task (estimating temporal intervals) repeatedly while simultaneously engaging in a motor task (walking on a treadmill). We found that the cognitive performance dynamics exhibited a qualitative change compared to when the cognitive task was performed alone. The cognitive dynamics during dual-task performance closely resembled uncorrelated, random white noise rather than the 1/f noise structure characteristic of single-task performance. This indicates that the concurrent motor task severs the dependence of current cognitive performance on past cognitive performance.

Cognitive performance loses its history, as it were, when performed while walking—a demonstration of a fundamental re-organization of cognitive performance in response to the background context of another task.

As a first step toward achieving the project goals listed above, we are currently identifying the dynamical structure of variability in children's estimates of temporal duration. Production tasks such as temporal estimation exhibit clear 1/f noise signals and thus have been studied extensively, but only in adults. In our first study children between 6 and 12 years old (N =16) repeatedly reproduced a duration of time by pressing a button each time they felt the duration had passed. To make the task engaging for young children, it was couched as a video game in which children have to produce "power" for a robot by pressing the button at a regular tempo. The target interval duration was 0.4 s, which was previously established by McAuley et al. (2006) as the preferred motor tempo of children between the ages of 4 and 12 years.

The target duration was demonstrated to children by initially playing a metronome during an initial familiarization phase. Children had to press the button in sync with the metronome beat for about 10 beats. Then the metronome was turned off and the child's task was to repeatedly press the button at the same tempo for the duration of a ten-minute trial. Every 20 sec "robot food" appeared on a computer display to break the monotony of the task. The display was not linked to children's actual responses, however.

Data collection is ongoing, but preliminary results indicate the presence of 1/f noise for the children's performance of the temporal estimation task. Detrended fluctuation analysis (DFA; Peng et al., 1995) was used to quantify the fractal scaling. DFA quantifies 1/f noise as the relation between a measure of variability (more specifically, the residual variability about the mean within a window of data after removing local linear trends) and time scale (the window size over which the variability measure is calculated). The variability measure, termed the detrended fluctuation function, is computed over multiple time scales and the relation between the value of that function and the time scale (i.e., the slope of a linear fit in double-logarithmic coordinates) expresses the fractal scaling. For classic 1/f or pink noise, this scaling exponent is ~1.0, and for white (random) noise, the scaling exponent is 0.5. Values between 0.5 and 1.0 are considered to reflect "whitened" pink noise, i.e., not pure pink noise, but not randomness, either.

The mean DFA scaling exponent value for our data thus far is 0.71, similar to the scaling exponent of 0.75 obtained for adults in the Kiefer et al. (in press) study. At this time no consistent developmental trends are apparent in the value of the scaling exponent. This may be due to the fact that tested children are not equally distributed across age groups. Nine children (56% of our sample) fall in the group of 6-7 year olds, with only three and four participants, respectively, in the 8-9 and 10-12 year old groups. Perhaps with additional participants in the latter two groups an age-related trend may appear (we hypothesize as such because developmental trends in fractal scaling exponents have been observed for motor tasks by Hausdorff et al., 1999).

Our immediate next step is to complete this project by collecting data from children in the 8-9 and 10-12 year age groups as well as in a 4-5 year old age group. After we establish the dynamics of single-task temporal estimation performance, in children we plan to conduct a dual-task study to determine if the change in cognitive dynamics observed in adults by Kiefer et al. (in press) occurs in children. After this we plan to investigate cognitive and motor performance dynamics in elderly participants.

Challenges and Opportunities:
There are two primary challenges associated with this research. The first is typical of research in cognitive and perceptual-motor development—devising procedures that are engaging enough to use with children yet controlled enough to yield reliable and valid results. The second, related problem is to develop nonlinear time series analysis methods that are reliable and accurate for use with shorter data sets than might be possible to obtain using adult participants. Toward that

end we are pursuing the use of recurrence quantification analysis to quantify fractal scaling in short, noisy, and nonstationary time series.

Project Title: Marginality in a Marginal Environment: An Agent-Based Approach to Population-Environment Relationships

Proposal Number: 0728822

HSD Emphasis: Dynamics of Human Behavior

Lead PI: Barbara Entwisle, University of North Carolina at Chapel Hill
Co-Is: Peter J. Mucha, Ronald R. Rindfuss, Stephen J. Walsh (UNC) and George Malanson (University of Iowa)
International Partners: Pramote Prasartkul, Yothin Sawangdee, Aree Jampaklay Mahidol University, Thailand

Project Goal:
Disasters large and small have the capacity to exacerbate inequalities at multiple levels. The tsunami in Thailand and Indonesia and Hurricane Katrina in the U.S. have attracted much attention, but events occurring at a more local scales, with less fanfare but often much greater frequency, are equally important. Researchers from two continents are collaborating on this study of the impact of floods and droughts as well as economic booms and crises on the adaptation of households and villages and trends in inequality in the short and longer run. Knowledge of the social responses to environmental change is important in anticipating the likely consequences of such change.

Thematic Areas:
- Population-environment interactions
- Vulnerability and resilience
- Complexity theory and systems dynamics

Methodologies:
- Agent-based microsimulation modeling
- Social network analysis
- Survey-based statistical analysis
- Multi-method field validation
- Landscape characterization and remote sensing
- Innovative approaches to sensitivity analysis

Recent Research Findings:
Across multiple social and spatial-temporal scales, marginal populations are especially likely to be affected by weather-related events, partly because of their location in marginal environments and also because of dynamic feedbacks involving human behavior. To test this hypothesis, we are using unique data assembled for Nang Rong, Thailand to:

- Develop an agent-based model of individual and household behavior in its social and environmental context
- Link people to the land through social surveys and remote sensing
- Develop new methods for sensitivity assessment
- Use the model to develop agent and system response to floods, droughts, and economic crises in the medium (5-8 years) and long (25-30 years) run

Our agent-based simulation is the first to incorporate feedbacks involving out-migration, return migration, marriage, residential choice, and household division in a spatially explicit model with land use and wealth as key outcomes. It incorporates dynamic social networks as both cause and consequence of behavioral change at the individual and household level. The position of households within village networks, and the structure of these networks overall, is important to understanding ecological and social vulnerability and resilience. Marginal households strongly

linked to other households in the village may be better able to weather bad years over the long as well as the short run. Starting values and model parameters come mainly from a household survey fielded in 2000 that collected detailed and spatially referenced information about households and household members, kin ties within and between households, and specific plots of land in 51 villages linked to a variety of spatial and biophysical coverages in a GIS.

Data preparation. A fundamental feature of the Nang Rong data for the modeling we propose is the link between households and field plots. We have given quite a bit of attention to the evaluation of these links and the degree to which information about field plots from different sources line up. We compared reports about the size and orientation of the same plots reported on separately in neighboring villages. We found congruence in most (87.9%) of the plots that could be compared in this way, and further, that a few villages located around the borders of the district accounted for many of the problems. We also were interested in plots used by more than one household. Sharing is fairly common in Nang Rong. Of the 11,702 plots reported by households using at least one plot, 1903 or 16% are plots that households are using jointly. We are using the "double reporting" to assess the quality of the plot attributes reported by households; in the longer run, joint use of plots can be incorporated into the modeling itself.

Model building. Our project has been underway for a year. Model building has been our main activity so far. Our initial model statement was published this year in the *Journal of Land Use Science* (Entwisle, Malanson, Rindfuss, and Walsh, 2008, "An Agent-Based Model of Household Dynamics and Land Use Change," *Journal of Land Use Science*). The article uses the language of mathematics and statistics to facilitate comparisons with other spatially explicit agent-based models.

We have since converted the equations from the *JLUS* article into a "picture model," created "pseudo code," and are now programming the model using tools from Repast Symphony. There are three modules: one for individual household members, one for individual field plots, and one for households. For each annual time step, these are run for all households in the village and the characteristics of individuals, plots, households, kin ties, and villages updated at the end of the time step. Programming so far has focused on the demographic components pf the agent-based model, including the simulation of birth, death, migration, and marriage; the dynamic designation of subfamilies and household division; and the kinship network of individuals and households. Satellite data have been examined, and our time-series extended, to examine land use/land cover in land parcels linked to households and villages and to environmental conditions.

Model assessment. In addition to standard approaches to evaluation, the project is borrowing and extending techniques from the fields of meteorology and control theory to develop new tools that have the potential to substantially improve the quality and efficiency of sensitivity analysis. Specifically, adjoint-based methods have been shown to yield usable gradients of simulation outcome observations with respect to model parameters, with most direct use in the context of continuously-varying degrees of freedom. However, challenges remain in developing the use of these techniques in discretely-varying conditions such as encountered with grids and in network topologies. Formulation of such techniques remains under active development.

Challenges and Opportunities:
The Nang Rong, Thailand data are unusual in collecting information about parent-child and spousal ties for the more than 30,000 individuals living in the 51 study villages in 2000. Knowledge of first-degree ties makes it possible to determine second-, third-, and higher degree ties (e.g., my grandparent is the parent of my parent). Missing data is a potential problem, however. Nodes may be missing (e.g., if my parent died before data collection began, it would not be possible to deduce the identity of my grandparent from reported first-degree ties). Edges may also be missing (e.g., omissions and other errors in survey reports). To get a handle on the extent of the problem and its consequences, we are simulating (generationally) complete kin networks on an annualized basis and then introducing node error, edge error, and combinations of the two.

Of particular interest are the consequences of error for the measurement of network characteristics (e.g., centrality of individuals or households, village cohesion).

Project Title: Modeling Community Response and Economic Impacts of Risk Amplification Following a Terrorist Strike

Proposal Number: 0728934

HSD Emphasis Area: Decision Making, Risk, and Uncertainty

Lead PI: William J. Burns
Co-PIs: Paul Slovic and Adam Rose

Project Goals:
To answer the following questions: 1) What are the requisite factors to adequately forecast the impacts of a disaster and most particularly a terrorist strike? 2) How can risk perception be incorporated into an economic model that predicts regional or national impacts? 3) How does resilience (the ability of a community to maintain function when shocked) affect predicted responses to catastrophic events? 4) How do these factors change and interact over time reflecting the dynamic nature of community response? 5) What are the important structural mechanisms that drive such change, especially system feedbacks and delays? 6) How do different responses to risk across gender, age, ethnicity, and income affect these mechanisms? 7) What perspectives and assumptions does a community bring to such a crisis that helps or hinders its ability to prepare, respond and recover? 8) What policies can be implemented that may mitigate the long-term impacts of such an event?

Thematic Areas:
- Risk perception
- Economic Impacts
- Disaster Threat (e.g.Terrroism)

Methodologies:
- Longitudinal Survey Analysis
- Growth Curve Analysis
- System Dynamic Simulation Modeling
- Computable General Equilibrium Economic Modeling (CGE)

Recent Research Findings:
Regarding the system dynamics model, for three scenarios (anthrax attack, bomb blast and propane tank explosion) intensity of investigation, media coverage, public risk perception, diffusion of fear and community intervention were simulated over a six month period. Terrorist attacks generated intense media coverage initially resulting in high perceptions of risk and diffusion of fear. Delays in community intervention contributed to higher and more prolonged levels of fear. Perceptions of risk rose very quickly but declined quite slowly. Likewise, implicit goals for the reduction of fear in a community may be worth examining more closely. These findings should prove useful to those wishing to predict public response to a variety of different contingencies involving terrorism.

Work for the CGE model mentioned above has begun but more work is yet needed to connect the system dynamics model with the CGE model.

Preliminary results from two longitudinal surveys indicate that terrorism creates higher levels of perceived risk, fear, worry, avoiding public places, willingness-to-pay to reduce risk and greater tradeoffs of privacy for security than earthquakes, even when the latter results in more deaths. Surprisingly, cyber-terrorism generated at least as much perceived risk as an anthrax release (though not nearly as much fear). Respondent comments suggest that this may be due to a high perceived likelihood that a cyber-attack could occur and that many people would be affected.

Hypothetical threat scenarios were developed and survey data was collected over a two year period. A hierarchical (i.e. multi-level) model has been developed to examine the importance of terrorism, mechanism, target or victim, motive behind disaster, negligence and casualties. Terrorism looms large with respect to perceived risk. The type of event (e.g., anthrax vs. propane tank explosion), target (e.g., tourist vs. government official), motive (e.g., accident vs. crime), and negligence are also important. Number of casualties does not appear to matter. There are also pronounced differences across individuals, which can partly be explained by gender. These findings underscore the importance of event characteristics when attempting to anticipate public response to hazards. They also point to the need to better understand contributing factors to individual differences in response.

Challenges and Opportunities:
The two current challenges for this study are 1) developing metrics that connect perceptions of risk following a threat event with economic impacts and 2) developing threat scenarios with sufficient realism to generate useful public response data.

Project Title: Context, Experience, and Market Anomalies: Behavioral and Neural Evidence

Proposal Number: 0729322

HSD Emphasis Area: Decision Making, Risk, and Uncertainty

Lead PI: Ali Hortacsu, University of Chicago
Co-PIs: Steven Small, Howard Nusbaum, John List; University of Chicago
Collaborator: Burak Guclu, Bogazici University, Istanbul, Turkey

Project Goals:

1. Understand the sources of two well-documented deviations from the standard assumptions of neoclassical economics: social (especially altruistic) preferences, and the endowment effect (or loss aversion). We complement behavioral data on these phenomena with neural imaging data to (i) investigate the neural mechanisms underlying the behavior, (ii) discriminate between alternative hypotheses and (iii) predict behavior in novel situations.
2. To investigate the use of event-related electroencephalography (ER-EEG) and dipole localization methods to complement fMRI data and to enhance the temporal resolution of neural measurements.

Thematic Areas:

- Neuroeconomics
- Behavioral economics/economic psychology

Methodologies:

- Behavioral experiments
- Functional magnetic resonance imaging (fMRI)
- Event-related electroencephalography (ER-EEG)

Recent Research Findings:

1) The Neuroeconomics of Altruism: the primary objective of this project is to deepen our understanding of the neural foundations of altruistic behavior. Our research pays particular attention to studying how altruistic behavior interacts with context: studying such interactions allow us to better pinpoint the psychological and neural mechanisms underlying behavior. We have made considerable progress in this project. We have completed a large number of behavioral experiments using the University of Chicago subject pool to study how giving behavior in dictator games are modulated by subtle modifications in context. We have replicated several findings in the dictator games literature that were originally found in one-shot experiments in a repeated trial setting (which is absolutely essential for fMRI imaging). Specifically, we have replicated earlier findings in the literature, obtained in one-shot settings, that subjects are less likely to give money to an anonymous counterparty if taking money away from that counterparty is an option (the classic dictator game experiment did not allow subjects to take money away). Interestingly, through our repeated trial design, we found that a subset of subjects do not alter their giving behavior in response to the availability of a 'taking' option. In fact, our behavioral experiments allowed us to classify subjects in dictator games into three broad groups: 'non-givers' (subjects who do not give any money in the dictator game trials), 'unconditional givers' (subjects who give the same amount regardless of the availability an option to take money away), and 'conditional givers' (those who switch their giving behavior when taking money away is an option).

Based on the promising results of our behavioral experiments, we have now begun conducting fMRI studies, which we hope to finish by the end of 2008. The fMRI imaging study will investigate whether different brain functions are responsible for the 3 categories of giving behavior we uncovered in our behavioral experiments.

2) The Endowment Effect and Market Experience: This project investigates whether the

endowment effect/loss aversion is displayed to a lesser extent by subjects who possess experience as traders in real-world markets. We are also seeking to identify neural markers of behavioral variations across experienced vs. inexperienced subjects. We also track the experimental subjects over time to examine the persistence of behavioral patterns, and whether market experience attained during the survey period is reflected in neural markers. To prepare for our broader subject recruitment drive in Fall 2008, we have attended several sportscard collectors shows to conduct surveys of Illinois based traders.

3) Utilization of EEG in neuroeconomics experiments: in collaboration with Dr. Burak Guclu at Bogazici University, we have collected behavioral and EEG data from subjects taking part in dictator game and intertemporal decision making experiments. We are currently analyzing the data to localize regions of electric dipole activity (using the software suite EEGLAB). We have added functionality to EEGLAB to correlate dipole locations with regions of interest uncovered in other brain imaging studies (primarily conducted using fMRI technology), as aggregated by the publication database BREDE. We are currently processing the large amounts data generated by the EEG experiments. Our pilot results suggest that EEG dipole localization methods may be able to uncover regions of dipole activity that are close to regions of interest identified by fMRI studies utilizing similar behavioral stimuli.

Challenges and Opportunities:
The main research challenge so far was to carry behavioral economics experiments into the fMRI scanning context, in ways that would not compromise the quality of imaging data. Through a number of pilot studies, we believe we have largely surmounted this challenge in the altruism study, and we are preparing for similar challenges in the endowment effects study. We also encountered a technical challenge due to the (unforeseen) breakdown and replacement of the fMRI scanner at the University of Chicago Brain Research Imaging Center. Fortunately, we have been able to find a home for our imaging experiments at Northwestern University's Center for Advanced MRI.

Project Title: Collaborative Research: DRU: Behavioral and Neural Effects of Sleep Deprivation on Specific Components of Decision Making

Proposal Number: 0729021

HSD Emphasis Area: Decision Making, Risk, and Uncertainty

Lead PI: Sean P.A. Drummond, PhD, University of California, San Diego
Co-PIs: David L. Dickinson, PhD, Appalachian State University and Jeff Dyche, PhD, United States Air Force Academy

Project Goals:

- To examine the behavioral effects of 26 hours total sleep deprivation (TSD) and 5 nights of partial sleep deprivation (PSD) on specific components of decision making
- To examine the cerebral effects of TSD and PSD on specific components of decision making
- To examine the behavioral effects of naturally occurring sleep loss on specific components of decision making

Thematic Areas:

- Decision making during experimental sleep deprivation and well-rested conditions
- Decision making during naturally occurring sleep deprivation

Methodologies:

- Total sleep deprivation
- Partial sleep deprivation
- Functional magnetic resonance imaging
- Cognitive assessment
- Actigraphy
- Polysomography

Recent Research Findings:
This study commenced in May 2008. As of September 1, 2008, we have enrolled 8 subjects into the 4-week protocol and 6 have fully completed.

Challenges and Opportunities:
Certainly, the biggest challenge in a project like this is likely to be recruitment. The protocol requires that subjects live in the laboratory for up to 5 consecutive days and nights. Fortunately, we have prior experience with such protocols and an infrastructure in place to manage the associated demands.

In terms of opportunities, sleep deprivation is increasingly common in modern society and has been estimated to cost the economy more than $55 billion a year. Given its pervasiveness, understanding how changes in brain function with sleep deprivation affect decision making is vitally important. The results of this study will increase our understanding of the basic neurophysiology of sleep deprivation and inform the burgeoning field of neuroeconomics by examining how common state changes (i.e., sleep loss) influence the behavioral and cerebral correlates of decision making. Importantly, two of the three studies are designed to generalize our experimental findings to the types of sleep loss experienced in the real world. This study also has the potential to influence how public policy responds to sleep loss in such critical areas as transportation, the military, education, and medical care.

Project Title: Salmon Harvests in Arctic Communities: Local Institutions, Risk, and Resilience

Proposal Number: 0729063

HSD Emphasis Area: Agents of Change

Lead PI: E. Lance Howe, Univ. of Alaska Anchorage
Co-PIs: James J. Murphy, Univ. of Alaska Anchorage; Colin T. West, Univ. of Alaska Anchorage

International Partners: Chukotka Association of Traditional Marine Mammal Hunters.

Project Goals:
Our research focuses on the rise and resilience of local institutions for managing subsistence harvests in indigenous arctic communities - particularly in light of unexpected shocks to resource abundance (i.e., aggregate risk). The objective is to better understand how aggregate risk influences the design and adaptation of local institutions which govern local common pool resources. In our case we focus on shared salmon fisheries and the use and sharing of harvests from these fisheries.

Methodologies:
Our approach is inter-disciplinary (economics and anthropology) and integrates both field and laboratory methods to address research questions in two culturally-linked regions on opposite sides of the Bering Sea. Taking a comparative approach, field research will be conducted in Yup'ik and Chukchi communities in western Alaska and the Chukotka Autonomous Okrug, Russia.

Our initial phase of research is ethnographic and consists of key informant interviews. The goal is to systematically document the local institutions governing community use of the fisheries. Phase two will consist of field and laboratory experiments that assess the effects of rules under uncertainty on harvest and sharing decisions. Ethnographic fieldwork will be used to inform experimental designs and to identify specific rules that will be embedded in experiments.

Year One Research:
This fall we completed the first year of our project. Over the past year our team conducted ethnographic fieldwork and began experimental research. Related activities included preparation for fieldwork and engaging communities and students in project research.

Ethnographic Fieldwork
We are working with a wide range of Kuskokwim River communities, from coastal to up-river places. Communities include Kalskag, Lower Kalskag, Tuluksak, Nunapitchuck, Tuntutuliak, and Chevak. Alaska ethnographic fieldwork started in full in June of this year. Anthropologist Dr. Colin West conducted all of the ethnographic fieldwork and was assisted by Ms. Uyuriukaraq Lily Anne Andrews Ulran, an indigenous Cup'ik research assistant from the village of Chevak.

In conducting the ethnographic fieldwork we used a purposive sampling strategy by which we interviewed individuals who were best qualified to inform our study based on the assessment of our contacts. Our community partners assisted in identifying elders, middle-aged, and young men and women in each village who have detailed knowledge of subsistence management strategies as well as the history of local fisheries. We interviewed around fifty individuals in the six communities, spending four to five days in each village. These interviews have been supplemented with participant observation activities whereby the researchers engaged in subsistence activities such as egg-gathering, drift-netting, set-netting, and wild plant-gathering.

Audio files from ethnographic fieldwork are currently being transcribed. Many of the interviews were conducted in Yup'ik and/or Cup'ik (a dialect of Central Yup'ik) and Ms. Ulran assisted in

translation and transcription. Dr. Colin West is preparing a white paper on preliminary findings as transcriptions are completed.

In preparation for this fieldwork we received valuable feedback on our research design from communities. An important part of the feedback process was a March 2008 project workshop we hosted in Anchorage where community representatives gathered to discuss the research and upcoming summer fieldwork.

Experimental Economics
The second phase of our research involves integrating ethnographic findings into experimental designs. Over the past year we have reviewed relevant literature, developed experimental software, and implemented preliminary experimental designs.

Dr. Jim Murphy and Dr. Lance Howe are working with Dr. West to develop experimental designs in light of ethnographic findings. Final designs will take shape after ethnographic work in Chukotka is in progress and interviews from the Kuskokwim have been transcribed. Designs for hand-run field experiments will first be tested in the experimental laboratory with student subjects and then run in participating communities in Chukotka and the Kuskokwim River region of Alaska.

Over the past year we have tested related experimental designs in the laboratory. One preliminary design builds on experimental literature in common pool resource dilemmas. Risk in this literature is modeled as a threshold distribution (Suleiman and Rapoport, 1988).[1] It implies that if the carrying capacity of a resource (which is unknown to the subjects) is exceeded the resource cannot replenish itself and collapses. Related experimental research consistently finds that as the range of the uniform distribution is increased subjects increase requests, a finding that has been described as "environmental optimism" (Rapoport & Suleiman, 1992).[2]

In our design, we model the distribution of the resource as stochastic because this feature is characteristic of the context we are studying. While our approach has been taking in analytical literature (Sandler and Sterbenz, 1990),[3] to our knowledge it has not been incorporated in any experiment. To date we have run approximately ten experimental sessions with this design. In contrast to existing research based on different experimental designs, we find that subjects tend to reduce harvests as risk increases. That is, rather than cooperation decreasing as risk increases we find evidence that cooperation actually improves as the distribution of a resource becomes more uncertain. In June we presented the results of this laboratory experiment at the International Economic Science Association Meetings.

In a second preliminary experimental design we concentrate on risk sharing and the distribution of subsistence resources. In the experimental environment subjects participate in a team production activity. We introduce idiosyncratic risk into the environment and then allow subjects an opportunity to share. Sharing is a treatment variable and we vary rules under which individuals are allowed to share. Our design allows us to test hypotheses related to risk sharing in social dilemmas (e.g. common pool resource and public good games).

Mr. Ben Saylor is developing experimental software based on the programming language Python. Once the project is complete we plan to make the base code of this software and relevant extensions available on the project webpage.

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[1] Suleiman, R. and A. Rapoport. 1988. "Environmental and social uncertainty in single-trial resource dilemmas." acta psychologica, 68(1-3), pp. 99-112.
[2] Rapoport, A. and R. Suleiman. 1992. "Equilibrium solutions for resource dilemmas." Group decision and negotiation, 1(3), pp. 269-294.
[3] Sandler, T. and F. Sterbenz. 1990. "Harvest uncertainty and the tragedy of the commons." Journal of environmental economics and management, 18, pp. 155-167.

Broader Impacts:
As mentioned, our project is working with six different traditional councils in Yukon-Kuskokwim delta communities and an indigenous partner organization in Chukotka Russia. In March we brought representatives together to discuss plans for summer ethnographic fieldwork and to discuss undergraduate student research projects for each community. Working with partner communities we identified five undergraduate students. Students conducted community-based research at home this past summer. This fall students will continue working with project researchers and communities in completing student projects. Alaska communities also played an important role in helping to facilitate summer ethnographic fieldwork. Graduate student Lance Kaufman also assisted us over the past summer by creating a panel data set from the Alaska Department of Fish and Game annual Kuskokwim Subsistence Harvest Survey data.

Challenges and Opportunities:
Plans for our second year include conducting ethnographic fieldwork in Chukotka and finalizing plans for field experiments. There are many logistical challenges in both cases. Recent events in Russia could complicate our access to Chukotka. At the same time, we are fortunate to have excellent support from our Chukotka partners and anticipate a successful year. Conducting field experiments in small, remote villages also poses a unique challenge. Careful planning is necessary to recruit an adequate number of subjects in each place and to avoid contamination of a small subject pool. Issues of cash incentive payments and saliency are also important. Before beginning field experiments we will further investigate how cash versus in-kind experimental incentive payments may influence decisions in the field experiments in unanticipated ways.

Project Title: Collaborative Research: Understanding Strategic Economic Interactions Through Cross-Species Analysis

Proposal Number: 0729244

HSD Emphasis Area: Decision Making, Risk, and Uncertainty

Lead PI: Sarah Brosnan, Georgia State University
Co-PIs: Bart Wilson, Chapman University and Michael Beran, Georgia State University

Project Goals:

- Test the hypothesis that humans and nonhuman primates share basic decision-making strategies in a cooperative economic game
- Test the hypothesis that humans make decisions that are more similar to those made by nonhuman species when humans are forced to learn the payoff structure through trial and error, as nonhumans do, rather than through active instruction (e.g. exposure to a payoff matrix and practice tests)
- Test the hypothesis that humans and nonhuman primates make different decisions when interacting with a conspecific via computer rather than via a human experimenter (e.g. an exchange methodology)
- Test the hypothesis that cooperation is more difficult to achieve when payoffs between individuals are different (unequal), and that each participant recognizes this inequity

Thematic Areas:

- Experimental Economics
- Evolution of behavior/ Comparative studies
- Cooperative decision-making strategies

Methodologies:

- Exchange/Trade
- Computerized economic games
- Comparison between species

Recent Research Findings:
Humans exhibit some of the most complex cooperation of any animal species on the planet. An excellent example is our contemporary economic system, in which each individual is reliant on others to provide most basic necessities. However, this cooperative ability is not unique to humans. Some of our closest living relatives, the primates, show abilities that are alike in kind, indicating that human behavior is a part of the same evolutionary trajectory as the rest of the primates. Despite these similarities, few studies have been done which directly compare human and nonhuman decision-making strategies in cooperative games, limiting our understanding of the evolution of human cooperation. In most cases, even when different species are compared, the methodologies are sufficiently variable that either methodological or taxonomic differences may account for the dissimilar results. Our research directly compares cooperative decision making across the entire primate lineage, including a new-world monkey species, an old-world monkey species, an ape species, and humans, to help understand how decision-making is different among these species. This broad comparison across the order *Primates* makes our data more meaningful to those interested in issues relating to primate behavior broadly, as well and to human evolution. With this information, we can more fully understand how human economic decision-making arose, which may provide insight into situations in which cooperative decision-making seems to fail.

Early results are quite promising. In light of Goals 1 and 2 (see above), at least some chimpanzees and humans show a tendency to cooperate when the pairs learn to play the Assurance game without instruction or previous knowledge of the payoff matrices. However, in

neither genus does every pair learn to cooperate (approximately ½ to ¼ do so), again showing significant similarity between the species. Compared to humans' play in a traditionally administered game, this is much lower. The preponderance of human pairs play the cooperative strategy when the payoffs are known and players are given explicit instructions in a 2 x 2 (normal form) matrix game, but far fewer do so when they must discern the payoff structure only through feedback from their repeated responses. Thus far capuchin monkeys are showing some preliminary evidence of cooperation, but we do not have enough data for definitive results.

In light of Goal 3, chimpanzees make many more cooperative decisions when playing a 'hands-on' exchange version of the Assurance game than when interacting over the computer. We are currently performing additional tests to follow upon our hypothesis that this is because they do not necessarily understand that the computer game is social. We do not have sufficient data on both versions in the other species as of yet, although no pairs have had difficulty learning to play the game on the computer. We have not yet begun data collection for Goal 4.

In a related side project, we have investigated how chimpanzees understand barter, to better understand how chimpanzees and humans compare in a different economic decision-making behavior. Chimpanzees easily exchange tokens for rewards, but rarely have their abilities to barter with objects which have use value been investigated. Chimpanzees do barter objects with use value rationally, trading objects of lesser value for those with greater. However, they will only do so when the difference in value between the objects is fairly large. We hypothesize that in their natural environment, the risks inherent in exchanging objects (e.g., that another object will not be returned) changes the costs and benefits such that the risk of loss is only worth taking in situations in which a significant gain is possible. Interestingly, in a follow-up study in which chimpanzees could barter tokens with one another, they only did so when a human experimenter was present to mediate the interaction. We hypothesize that, in the absence of control mechanisms (such as a legal system), the risks of barter are too high and so barter is rarely a reasonable option for chimpanzees. Although these projects do not directly address cooperation, understanding barter in chimpanzees does provide a better understanding of other ways in which humans and nonhuman primates differ in economic decision making. The reasons for superior ability in humans in the case of barter – for instance, the ameliorated risk due to more advanced control mechanisms – may also help explain superior human ability in other areas, such as cooperation.

Because this work is a collaboration between fields, we represent the disciplines of economics, psychology, and animal behavior, and so are in a good position to spread this information across many disciplines. Although the primary contribution of our work is to economics, the emphasis on a more evolutionary understanding of decision-making will also have profound implications for psychology, as we can address why people make the decisions that they do, and which factors influence these decisions. In a more applied way, this work may also inform the discipline of law, which includes an increasing number of researchers looking for biological and evolutionary explanations for behavior. Already, related work on the endowment effect has been published by one of us in a Law Review. Our work contributes to animal behavior not only by providing a better understanding of cooperation – a topic which is much researched in the field – but through development of our paradigm for testing primates playing games against one another. Finally, this work addresses anthropology and evolutionary biology, by placing humans into context with the other primates and, by proxy, the rest of the animal kingdom.

Challenges and Opportunities:
In the existing literature, human and non-human studies are routinely compared, yet the methodologies and protocols virtually always differ extensively, due to the unique challenges of running economic experiments on non-verbal organisms. One significant challenge for us has been designing studies that are realistic for both human and non-human primate species to understand, and yet can have results that are meaningful for all species and relevant to the existing literature. Through the use of extensive controls, we can 1) verify that individuals understand the tasks and 2) compare these results to those from more traditional normal-form

games in humans. Thus, we have been able to bridge this chasm across species and methodologies. We think this is an excellent opportunity to develop such paradigms for a variety of non-verbal individuals of all species.

Project Title: Intercultural Knowledge System Dynamics in Complex Services Outsourcing

Proposal Number: 0729253

HSD Emphasis Area: Agents of Change

Lead PI: John E. Taylor, Columbia University
Co-PIs: Sirkka Jarvenpaa, University of Texas at Austin; Elizabeth Keating, University of Texas at Austin

International Partner: Ashwin Mahalingam, Indian Institute of Technology; Riitta Smeds, Helsinki University of Technology

Project Goals:

- Client engineering firms have begun to outsource services of much broader scope and higher complexity to international service providers. The complexity of offshoring this multifaceted design work combined with cultural differences across engineering teams can lead to inefficiencies that must be addressed to ensure the long-term success of such interactions. This research project examines three complex design projects to understand, model and make recommendations to improve the offshore outsourcing of complex design services.

Thematic Areas:

- Boundary Object Change in Global Design Offshoring Networks
- Transactive Memory Systems in Global Design Offshoring Networks
- Coordination Mechanisms in Global Design Offshoring Networks

Methodologies:

- Longitudinally examine three complex design projects involving onshore design client working together with an offshore design service provider to identify specific instances of knowledge system conflict
- Ethnographic Observation of meetings, enactment of work
- Semi-structured Interviews with project participants

Recent Research Findings:

Although tentative at this point, we have developed a list of observations as follows related to the cross-cultural interactions between the U.S.-based and Romanian designers after 9 months of observation of this design firm dyad:

1. We observed problems in alignment of the two groups of engineers and project managers, and suggest paying more attention to:
   a. Recognition of misalignment
   b. Compromises to find common ground between different cultures (identity, how pride in individual work is expressed, interpersonal relations) and practices (engineering)
   c.
2. More predictability in feedback and information seeking needed
   a. In time (how long to wait for an answer)
   b. In format (email vs phone, time and focus, shared documents)
   c. Develop more clarity on how to ask questions
      i. The expectations of questions; what is the role of questions, the role of hierarchy/familiarity in constraining question asking and answering
      ii. currently a lot of ambiguity (and possibly contradictory messages) about how to ask questions, to whom to address questions, and when to ask them
   d. Use more positive feedback on things done well
   e. Focus how disagreement can be managed in achieving shared and unshared team goals
   f. Develop incentives or penalties to improve information seeking and feedback

3. Better understand and manage expectations of the other cultural group's behavior, outlook, and standard communication habits (e.g. sincerity, politeness [e.g. polite pronoun usage in Romanian, directness], joking, hierarchies), and culturally valued or historical leadership styles
a. People need to travel to the other side for a longer duration, e.g. two weeks
i. A tremendous amount of work can be achieved efficiently in exchange of visits
ii. Relieves isolation
iii. Builds better communication routines
iv. Gives context for understanding communication, reasoning, and context
v. Currently a lot of uncertainty because of integration of different approaches
4. Create the role of a dedicated site manager in the USA to maximize efficiency
a. New career position between project managers
i. Person who understands engineering and has excellent interpersonal skills
5. Create retainer relationship for Romania to manage costs and resources optimally and reduce conflicts in goals
6. Use better conferencing software and work flow management software
a. Use webcams or video system for utilizing visual communication forms, e.g. level of engagement or attentiveness (is an addressee engaged in a side conversation, what is the non-verbal feedback), understanding, affirmation or potential disagreement; jokes work better with visual signs of appreciation and regard for the other; building relationships through sharing visual space and attunement
b. Use better management software to synchronize information and work
7. Better awareness of personal or team feelings of being disrespected or disregarded by the other team; issues of superiority of one side in cross cultural collaboration
a. differences in knowledge systems, training, assumptions that everyone already knows "the way 'we' do things" can hamper good teamwork if one group feels their competency is degraded, lower ranked or of lower standing or dismissed as not the accepted way
b. understanding pride and negotiating practices in Romania
c. Appreciating Romanian eagerness to learn, looking for learning opportunities
i. Romanians are currently working professionally with several different cultural models: German, Hungarian, French, American
d. "we" vs "you"
8. More positive feedback (see also item 2d) would be beneficial.
a. There are cultural differences in the amount or type of positive feedback that is expected to feel that things are going well
b. use visible recognition rewards across groups, e.g. ceremonies which include public visible recognition.
i. Symbols of achievement are important in both cultures
9. Limited number of software licenses can be a problem in generating good work flow and use of limited personnel
10. Generational differences among same culture teams are significant (belief systems, experiences, goals, career paths, early opportunities for leadership, values)
11. Retention issues are a problem in a profession where head-hunting is going on
a. What measures are being used to increase retention?
12. What kinds of "group think" are standard between groups and among same groups, e.g. culture, employees vs. managers, Romania vs USA
13. Better understanding of what collaboration means in Romania vs USA
a. Role of individual creativity (Romania—prior to 1989 you had to be extremely inventive and original in solving problems within hardship conditions)
b. What are significant cultural aspects of motivation; how to motivate
c. What does openness mean in Romania vs USA
d. What is the role of universities
14. Language issues: how to recognize when use of American slang or metaphorical language by USA side is misunderstood or meaning not captured

Challenges and Opportunities:
Getting access to the data collection sites has been far more challenging than expected. At the executive level there is clear interest in understanding how to improve the offshore outsourcing process, however, at the project level the project managers are resisting the idea of researchers investigating their processes in depth.

Several very interesting opportunities have emerged that we did not anticipate. We have identified the role of a cultural boundary spanner in the team and undertook an experiment to examine in more depth the role of cultural boundary spanners on global virtual teams. We also applied key learnings from the research to examine whether the robust organizational design for a global/multi-cultural versus a domestic/mono-cultural varies and found that they do vary. This has significant implications for firms operating in global networks designing their project network organizations.

Project Title: Collaborative Research: (DRU) Modeling Business Return Amid Post-Disaster Uncertainties: News Orleans After Katrina

Proposal Number: 0729259; 0729264; 0729472

HSD Emphasis Area: Decision Making, Risk, and Uncertainty

Lead PI: Nina Lam, Louisiana State University
Co-PIs: Kelley Pace, Louisiana State University; James LeSage, Texas State University; Richard Campanella, Tulane University

Project Goals:
The project seeks to develop models to quantify determinants of the decisions by businesses to return after a disaster. Special attention will be given to the spatial relations between a business, its neighborhood, and businesses located nearby. Four specific objectives are:

- Extend current spatial statistical methods to address data and modeling issues such as spatial dependency, sample selection bias, and model uncertainty.
- Develop statistical models to estimate the relation between business recovery and various decision factors.
- Evaluate alternate spatial strategies for aid distribution to maximize recovery.
- Generalize our findings to other locations.

Thematic Areas:

- Disaster and economic recovery
- Decision making under uncertainty
- Resilience, vulnerability, and sustainability

Methodologies:

- Statistical and spatial econometric modeling
- Telephone survey
- Field survey (street survey)
- GIS, remote sensing, and mapping
- Optimization and simulation methods

Recent Research Findings:
The project started on November 1, 2007. We are in the process of completing first-year tasks which include: (1) development of estimation methods and software; (2) integration of data from the street surveys, telephone surveys, and other external data; and (3) statistical analysis of the telephone survey data.

Some finding highlights from the three telephone surveys of all businesses (about 10,000) in the Orleans Parish conducted in December 2005, June 2006, and October 2007 are:

1. In December 2005, approximately four months after Katrina, only 28% of the businesses were open. In June 2006, this number increased to 41%, whereas in October 2007, more than two years after Katrina, only about 60% of the businesses reopened. This indicates some progress of economic recovery, but it is a slow one.
2. Moreover, only half of the businesses answered that their businesses were better or about the same in December 2005. This number increased to about 60% in the second and third surveys, which also indicate that for those businesses which reopened, about 15-20% were struggling or in danger of closing.
3. Businesses were not satisfied with the recovery progress, with more than half (56%) rated the recovery progress as unsatisfactory in June 2006. This number was slightly decreased to 47% in October 2007.

4. When business owners were asked to rate a series of problems considered barriers for their return in a post-Katrina environment, levee protection was found to be their main concern at the beginning. However, as time progresses, more business owners considered utilities and communications as the two other most important issues they were facing, in addition to levee protection. These were followed by problems of damage to the premises and lack of employees.

In addition to the telephone survey, street surveys of businesses openings along three commercial corridors: St. Claude Avenue, Magazine Street, and Carrollton Avenue have been conducted weekly starting October 9, 2005, approximately one month after Katrina. By this autumn (2008), we will have a complete three-year data set. However, based on the initial data tabulated in January 2007, we can observe the following:

1. Reopening rates by street: Magazine Street, a prosperous corridor which did not flood, reopened at a rate of 93%; Carrollton, a middle-class avenue which flooded deeply in many areas and less so in others, reopened at 46%; St. Claude Avenue (lower class and consistently lightly flooded) reopened at 48%.
2. By ownership: locally owned, independent businesses reopened fastest, compared to regional chains and national chains.
3. By economic status and size: small and medium-sized businesses serving middle- to high-end clientele reopened in the largest numbers.
4. By business category: businesses serving “needs” (food retail, pharmacies, auto repair) reopened slower than those serving the “wants” (restaurants, coffee shops, bars, spas, etc.).
5. By flood depth: roughly every additional foot of floodwater diminished the reopening rate by 10%.
6. By census tract medium household income: a decline by $10,000 in income corresponded to a roughly 25% decline in business reopening rates.

These empirical findings/rules will serve as valuable input to our modeling task in the next research stage. The same rules will be used to model the results from both the telephone survey and street survey, so that the final model of business return will be more robust and generalized.

Challenges and Opportunities:
The project involves different types of spatial-temporal data and a number of methodologies; hence expertise from different disciplines is required. Reconciling the various data layers and methodologies into a model-based framework presents a great challenge.

Some of the methodological challenges include: (1) Survey variables that have been collected represent either ordered discrete or ordinal variables. Since these variables were measured with reference to location in an urban area, it seems likely that these variables will violate the traditional assumption of independence. The presence of spatial dependence and non-continuous data will present challenges for our statistical modeling endeavor. (2) Our survey responses may exhibit self-selection bias, since potential respondents with very serious problems would be less likely to answer phone calls. Given that these form the basis for inference regarding the operational status of establishments, self-selection bias could play an important role in this analysis. (3) There are numerous model specifications based on alternative combinations of explanatory variables as well as differing types of spatial regression model specifications. Model selection techniques that can be used to reduce model uncertainty will need to be explored.

The project also presents valuable opportunities for interdisciplinary research for research scientists and students. Moreover, the project will involve a number of undergraduate students for telephone survey in the coming year, thus providing valuable work experience for these students. The analytical tools, software, and methodology developed from this project will be useful to other similar studies. Furthermore, through our outreach activities, we were able to develop collaborations with other governmental agencies, such as the Louisiana Recovery Authority and

the Gulf of Mexico Sea Grant Program, to expand our data collection effort as well as apply our model results to other Gulf Coast regions.

Project Title: Issue Adoption in Transnational Advocacy Networks

Proposal Number: 0729279

HSD Emphasis Area: Agents of Change

Lead PI: Charli Carpenter, University of Massachusetts
Co-PIs: Stuart Shulman, University of Massachusetts
International Partners: James Ron, Carleton University; Richard Rogers, University of Amsterdam

Project Goals:

- Measure variation in the salience of human rights issues
- Explore reasons for this variation through a series of focus groups with activists from leading organizations in the human rights network.
- Annotate the resulting text-data.

Methodologies:

- Hyperlink analysis of advocacy websites
- Interviews / focus groups / surveys
- Content analysis of resulting text-data

Recent Research Findings:
Data has not yet been analyzed as we are still in the data generation phase. A hyperlink analysis of both the human rights network and the separate human security networks have been undertaken using automated tools developed at University of Amsterdam. Through this, we are identifying a population of central organizations in these networks – the population from which our survey and focus group respondents will be drawn.

To begin capturing the issue agenda from within this network, text-datasets of web content from both hyperlinked websites were gathered. Issue language from these datasets was identified and a frequency analysis of this language within the entire network has been completed using automated tools. Effort was made to begin developing a qualitative coding scheme for measuring the more general issue agenda within this dataset.

To triangulate both the hyperlink analysis (which tells us which organizations are prominent in the network) and the content analysis (which tells us about the issue agenda), we have sought survey and interview data from the human rights networks. Jim Ron of Carleton University undertook two waves of in-depth interviews with human rights activists in Montreal, to triangulate with online surveys disseminated to the human rights network (which we assume will be biased in favor of the global North due to the digital divide). A total of 57 valid interviews were collected with human rights activists from developing countries. An online survey was created for the human rights network, but was not yet disseminated as we are still negotiating access to mailing lists in order to disseminate it. However, the survey has been piloted for a second, related network – the human security network - using Survey Monkey software and a mailing list from the Human Security Report project. 269 survey responses on the “human security network” were collected, allowing the PI to refine the survey for use on the human rights network.

In addition to these steps taken toward completing the research, a project website was constructed, nine graduate students were trained at University of Pittsburgh and three at Carleton University, several conference presentations have been made, and the research project has been integrated into the PI’s teaching.

Challenges and Opportunities:

This year, a great deal of time was spent simply rethinking the assumptions of the initial research design. First, some of the concepts on which the project rests had been underspecified before we began the work. We discovered, for example, that it is not so easy to operationalize concepts from the literature like “issue” or “agenda” or “issue salience.” In the end, our content analysis led us to conclude that activists actually understand these terms to mean something rather different than scholars; our working definitions now reflect this new understanding.

Second, although our original research design had focused heavily on the data annotation process, we discovered that simply generating the data required a form of “coding” in itself. In particular, figuring out which relevant text to pull off of websites for coding required qualitative judgments by the graduate students trained to create the data, and developing a process for doing this systematically was a challenge. However it was also an opportunity to learn about how issues get framed on websites, how much variation exists in the format of different advocacy websites, and helped us refine our operational concepts (like, what is an “issue”? – see above). In the end, we created a set of structured protocols to guide data generation that focused on advocacy organization mission statements and text from the pages where they defined the “issues.” This was replicated for each organization appearing in the hyperlinked “human rights network,” resulting in a set of text data that will be analyzed next year by a trained team of coders.

A logistical challenge occurred when the PI transferred from University of Pittsburgh to University of Massachusetts this summer. Transferring the grant between institutions has slowed the research process: little progress has been made since late summer. The relocation also necessitates the establishment and training of a new set of graduate student researchers. This is underway. In the meantime, while actual work on the project awaits the approval by the NSF of a new budget, the PI has integrated the research questions and design into a new graduate course being taught at the University of Massachusetts, entitled “Global Agenda-Setting.” In this course, graduate students are studying the existing literature on advocacy networks and are applying its insights in a structured, focused comparison to a number of successful cases, to further refine / modify the model of issue emergence we are building.

Project Title: Agents of Change in Agriculture and the Environment: Land-User Interactions and Spatial Externalities in Organic Farming (Upper Midwest, USA) and Agrobiodiversity Production (Bolivia)

Proposal Number: 0729297

HSD Emphasis Area: Agents of Change

Lead PI: Karl Zimmerer, Penn State/UW-Madison
Co-PIs: Brad Barham, Amy Burnicki, Jim Burt, Dave Lewis (University of Wisconsin-Madison)

International Partners: Agroecología Universidad Cochabamba (AGRUCO)

Project Goals:
The primary goal of the project is to explore farmer-farmer interactions and how they shape land use decisions, especially the clustering of organic dairy farming (Wisconsin) and high-agrobiodiversity maize (Bolivia). Empirically, clustered land-use patterns are evident as the certification of organic (dairy) farmers shows disproportionate numbers located in certain areas and sub-areas within Wisconsin, but region- or county-level observations beg the question of how the expansion of organic dairy-farming occurs at the sub-region (e.g., watershed) level and the specific role that farmer-farmer interactions may play in that process. Similarly field-level observations indicate that the production of high-agrobiodiversity maize involves the spatial clustering of fields at the sub-region scale, as well as over larger areas. Our study aims to identify the role of these interactions using a variety of methods that span a qualitative-quantitative continuum and a "revealed" versus "stated" preference continuum.

Thematic Areas:
The human-social dynamics in farmer-farmer interactions and the effects of spatial externalities are, we hypothesize, crucial to the profound and rapid changes affecting organic dairy farming and high-agrobiodiversity maize cultivation. Examining spatial externalities adds a new dimension to understandings of agricultural change based on wealth-activity portfolio and market stimulus approaches to technology/farming system adoption choices. Empirically land-use patterning based on clustering is emerging as the certification of organic (dairy) farmers shows disproportionate numbers located in certain areas and sub-areas.

Methodologies:
Our core study methods include: spatial and temporal statistical analysis of the expansion of organic dairy farming based on bio-physical, infrastructure, transport, processing plant, and other data that can be used to identify patterns of clustering and their correlates; historical and ethnographic accounts of farmer-farmer interactions as well as broader institutional initiatives aimed at promoting the adoption of organic farming; econometric analysis of farmer decisions to go or not go organic based on survey data and spatial/temporal data; and, "industrial organization" analysis of the evolving organic sector and the role of farmer-farmer interactions in creating new marketing and distribution entry.

Multiple types of data will be utilized. In the Wisconsin component of the project all dairy farms (organic and conventional) in the western region will be geo-coded and linked to multiple land use, soil quality, and bio-physical databases. These spatial data will be augmented by detailed data from the leading organic dairy cooperative in the region and other major buyers (Dean Foods) to provide information on farm and farmer characteristics, as well as by on-farm survey data gathered on organic and conventional farms. Entry timing and location of organic processors will be added to this data, with a particular eye toward the latest marketing trend which is the growth of a "competitive fringe" of farmer-driven, "locally" marketed organic dairy products.

Development of the spatial database needed for the Wisconsin side of the project is well under way. Tax records were used to acquire data on owner-occupied organic farms, and we are

cooperating with the major organic certifier in the region to identify rented organic parcels. For Bolivia, we have an analogous aim to develop a field-level database that distinguishes between high and low biodiversity cultivation (roughly maize versus orchards). Because suitable centralized records do not exist, we are using remotely sensed images for this purpose. Field boundaries digitized from the Quickbird images will be fed to an object classifier allowing each field to be labeled as biodiverse or not. Additionally, an argument can be made that because larger fields are more biodiverse, a quantitative measure of biodiversity can be constructed by some appropriate scaling of field size. Join-count analysis and other spatial autocorrelation techniques will be used on the Wisconsin and Bolivian datasets to detect clusters of organic farms and high biodiversity fields. The goal of this preliminary statistical work is to better understand and characterize patterns of clustering seen in the two study areas, and to inform sampling design for interviews in Bolivia slated to begin in early 2009. In addition, these data will serve as validation datasets for econometric models developed later in the project.

Recent Research Findings:
Field study in Bolivia this summer showed that the peasant smallholder production of high-agrobiodiversity Andean maize in the Calicanto area of central Bolivia has undergone spatially uneven impacts due to the locally widespread expansion of peach farming (in medium-size fields), which has partly replaced this maize production and almost completely that of alfalfa (previously the main land use alternative to high-agrobiodiversity Andean maize). Preliminary findings are that there is a major role of spatial externalities in the land use change processes there (i.e., expansion of peach growing) and in the continuation of high-agrobiodiversity maize growing. Institutional influences include the following: the Manejo de Cuencas del Río Caine; the local communities; and the Irrigators Association. The latter institution is clearly the most influential as a result of decision-making concerning the timing and extent of the distribution of irrigation water, which, due to infrastructural improvements, represents a sizeable economic "shock" that is resulting in land use change in the area. High-resolution satellite imagery (Quick Bird, .4 meter resolution) has been acquired and is being processed for spatial analysis. Preliminary use of the imagery shows good identification of the clustering of both high-agrobiodiversity Andean maize and the peach orchards resulting from economic-induced peach growing.

Challenges and Opportunities:
There are abundant challenges and opportunities faced in this project. One concerns the unevenness of the field-level and farm-level data between the study regions. In Wisconsin we have been successful in building a database of farm ownership and face the challenge of identifying land use in the rental market (i.e., the rental of fields for organic dairy and other land use). At the same time, we have not yet determined land cover categories at the field level. In Bolivia we are approaching data collection in a different manner due to data availability. We are working successfully with high-resolution spatial imagery of fields in the Bolivia study area, although acquiring the data on field ownership and field rental will be far more challenging.

Project Title: DHB/Collaborative Research: Using machine learning to model the interplay of production dynamics and perception dynamics in phonological acquisition

Proposal Number: 0729306

HSD Emphasis Area: Dynamics of Human Behavior

Lead PIs: (1) Mary E. Beckman, Ohio State University; (2) Benjamin R. Munson, University of Minnesota; (3) Jan Edwards, University of Wisconsin – Madison
Co-PIs: Eric Fosler-Lussier, Ohio State University

International Partners:
None listed as collaborators on the original proposal, although we continue to tap connections developed in an earlier NIDCD-funded project that provided much of the cross-linguistic speech production data. For example, we have taken advantage of complementary research aims of Dr. Kiyoko Yoneyama at Daito Bunka University in Tokyo (who supervised the recording of words produced by Japanese toddlers and adults in the NIDCD project) in a barter exchange relationship whereby Dr. Yoneyama and her graduate students run our perception experiments involving Japanese-speaking participants in Tokyo in exchange for Dr. Munson and his students running her perception experiments involving English-speaking participants in Minneaopolis.

Project Goals:
- To use acoustic modeling techniques that are currently being developed for robust Automatic Speech Recognition (ASR) to explore how the higher-level cognitive, social, and linguistic processes and lower-level sensory-motor processes that are relevant to speech production and perception in any given speech community come to be internalized by normally developing children.
- The following specific questions will be addressed in developing the models:
    1. How do adult speakers from different speech communities perceive the acoustic patterns in words pronounced by speakers of different ages?
    2. How do adult stereotypes about children's productions shape speech addressed to children?
    3. How do adult's perceptual responses to children's (mis)articulations shape the course of children's mastery of the community-specific patterns?

Thematic Areas:
- Cognition, Language, and Modeling: See Project Goals, and next Thematic Area.
- Complex Systems: Spoken language is richly structured at many different levels of representation. At the articulatory-motor level, speaking involves a complex coordination of gestures engaging the respiratory system, the larynx, the tongue, and the lips. At the acoustic-auditory level, speech perception involves a complex parsing of signal properties that simultaneously cue who the talker is, what the intended utterance is, and what the intended utterance melody is. At other levels of representation, these parametric representations are mapped onto lexical-phonetic categories such as "the consonant phoneme [k] in *cat*" and also onto socio-indexical categories such as "voice of a young girl from NY".
- Interdisciplinary Research/Training: The faculty and students involved in this project come from very diverse fields, including linguistics, speech and hearing science, and computer science. This is necessary, given the diverse set of skills needed for the project, including expertise in programming statistical models, expertise in acoustic analysis, and experience in designing perception experiments with children and adults. By working together to analyze and model data gathered at many sites, our students develop expertise in other areas. In addition, we take advantage of each others' courses. For example, PI Beckman and several graduate research associates from her lab attended PI Fosler-Lussier's seminar on Machine Learning for Language Technology

during Autumn, 2007, and one or more of his students take her Phonetic Theory course taught each Autumn.

Methodologies:
There are four main sets of methodologies that we are using at present.

- Child-directed and adult-directed speech: We record mothers (or other primary caretakers, such as grandmothers) interacting with the adult interviewer or their 12-to-24 month old infants, and will incorporate analyses of differences between the two interaction/speaking styles into our models. In the first year of the project, we supplemented our earlier recordings with new recordings of Mandarin Chinese speaking mothers/grandmothers.
- Perception experiments: Another primary focus in the first year of the project has been on developing psychometrically valid measures of adults' perception of the accuracy of children's speech production. This has involved developing and comparing responses using a number of different experimental tasks. For example, in one set of experiments, we use a forced choice response followed by a direct magnitude estimation of "goodness" of stimulus to how adult speakers of English, Japanese, and Mandarin Chinese characterize children's productions of target "s" and "sh" (and, for Mandarin-speaking children, "shy") consonants in terms of the two (or three) consonant categories of the language.
- Acoustic analyses: We continue to develop psychoacoustic measures of signal dimensions that we correlate with adults' perceptual responses to contrasting sounds across languages (such as the contrast between "s" and "sh" in English and Japanese), so that we can understand how to incorporate the results of the cross-linguistic perception experiments into the models.
- Modeling: We incorporate results of above into the model design (see next).

Challenges and Opportunities:
An important and unexpected result of the perception experiments is that there are differences in response pattern not just across the different language groups, but also across individuals who share a common first language. Some participants show considerable sensitivity to fine phonetic detail in their goodness ratings, and others respond more categorically. This result (which has been consistent across several tasks, stimulus sets, and languages) gives us clues to the different levels that we need to model and the complexity of the interactions among them. In the next year of the grant, we will do a second iteration of experiments to better understand these individual differences.

Project Title: Context, Experience, and Market Anomalies: Behavioral and Neural Evidence

Proposal Number: 0729322

HSD Emphasis Area: Decision Making, Risk, and Uncertainty

Lead PI: Ali Hortacsu, University of Chicago
Co-PIs: Steven Small, Howard Nusbaum, John List; University of Chicago
Collaborator: Burak Guclu, Bogazici University, Istanbul, Turkey

Project Goals:

1. Understand the sources of two well-documented deviations from the standard assumptions of neoclassical economics: social (especially altruistic) preferences, and the endowment effect (or loss aversion). We complement behavioral data on these phenomena with neural imaging data to (i) investigate the neural mechanisms underlying the behavior, (ii) discriminate between alternative hypotheses and (iii) predict behavior in novel situations.
2. To investigate the use of event-related electroencephalography (ER-EEG) and dipole localization methods to complement fMRI data and to enhance the temporal resolution of neural measurements.

Thematic Areas:

- Neuroeconomics
- Behavioral economics/economic psychology

Methodologies:

- Behavioral experiments
- Functional magnetic resonance imaging (fMRI)
- Event-related electroencephalography (ER-EEG)

Recent Research Findings:

1) The Neuroeconomics of Altruism: the primary objective of this project is to deepen our understanding of the neural foundations of altruistic behavior. Our research pays particular attention to studying how altruistic behavior interacts with context: studying such interactions allow us to better pinpoint the psychological and neural mechanisms underlying behavior. We have made considerable progress in this project. We have completed a large number of behavioral experiments using the University of Chicago subject pool to study how giving behavior in dictator games are modulated by subtle modifications in context. We have replicated several findings in the dictator games literature that were originally found in one-shot experiments in a repeated trial setting (which is absolutely essential for fMRI imaging). Specifically, we have replicated earlier findings in the literature, obtained in one-shot settings, that subjects are less likely to give money to an anonymous counterparty if taking money away from that counterparty is an option (the classic dictator game experiment did not allow subjects to take money away). Interestingly, through our repeated trial design, we found that a subset of subjects do not alter their giving behavior in response to the availability of a 'taking' option. In fact, our behavioral experiments allowed us to classify subjects in dictator games into three broad groups: 'non-givers' (subjects who do not give any money in the dictator game trials), 'unconditional givers' (subjects who give the same amount regardless of the availability an option to take money away), and 'conditional givers' (those who switch their giving behavior when taking money away is an option).

Based on the promising results of our behavioral experiments, we have now begun conducting fMRI studies, which we hope to finish by the end of 2008. The fMRI imaging study will investigate whether different brain functions are responsible for the 3 categories of giving behavior we uncovered in our behavioral experiments.

2) The Endowment Effect and Market Experience: This project investigates whether the

endowment effect/loss aversion is displayed to a lesser extent by subjects who possess experience as traders in real-world markets. We are also seeking to identify neural markers of behavioral variations across experienced vs. inexperienced subjects. We also track the experimental subjects over time to examine the persistence of behavioral patterns, and whether market experience attained during the survey period is reflected in neural markers. To prepare for our broader subject recruitment drive in Fall 2008, we have attended several sportscard collectors shows to conduct surveys of Illinois based traders.

3) Utilization of EEG in neuroeconomics experiments: in collaboration with Dr. Burak Guclu at Bogazici University, we have collected behavioral and EEG data from subjects taking part in dictator game and intertemporal decision making experiments. We are currently analyzing the data to localize regions of electric dipole activity (using the software suite EEGLAB). We have added functionality to EEGLAB to correlate dipole locations with regions of interest uncovered in other brain imaging studies (primarily conducted using fMRI technology), as aggregated by the publication database BREDE. We are currently processing the large amounts data generated by the EEG experiments. Our pilot results suggest that EEG dipole localization methods may be able to uncover regions of dipole activity that are close to regions of interest identified by fMRI studies utilizing similar behavioral stimuli.

Challenges and Opportunities:
The main research challenge so far was to carry behavioral economics experiments into the fMRI scanning context, in ways that would not compromise the quality of imaging data. Through a number of pilot studies, we believe we have largely surmounted this challenge in the altruism study, and we are preparing for similar challenges in the endowment effects study. We also encountered a technical challenge due to the (unforeseen) breakdown and replacement of the fMRI scanner at the University of Chicago Brain Research Imaging Center. Fortunately, we have been able to find a home for our imaging experiments at Northwestern University's Center for Advanced MRI.

Project Title: Social, Economic, and Political Aspects of U.S. Ethanol Policy

Proposal Number: 0729348

HSD Emphasis Area: Decision Making, Risk, and Uncertainty

Lead PI: Duane T. Wegener, Purdue University
Co-PIs: Leigh S. Raymond and Wallace E. Tyner, Purdue University

Project Goals:

- Examine the economic consequences of seven alternatives for US ethanol policy for both ethanol producers and, where evident, for the financial burden on consumers when certain energy prices are present in the market
- Identify public reactions to the policy options, both locally (for its implications in our laboratory work on decision processes) and across the US (including a comparison of public reactions across states that differ in their environmental restrictions on use of GMOs for energy production), comparing public opinions with those of relevant policy-makers
- Test the role of individual attitudes and political values in decision processes related to ethanol (both for choices between policies themselves and for choices between politicians who support different policies)

Thematic Areas:

- Economic analysis of ethanol policy
- Public and policy-maker opinions surrounding ethanol and biofuels
- Decision-making

Methodologies:

- Economic modeling
- Focus groups and individual interviews
- Laboratory experiments

Recent Research Findings:
The economic analyses are proceeding quite well. Dr. Tyner and his colleagues have published several papers on the estimated impacts of the different policy alternatives. The alternatives evaluated to date include the fixed ethanol subsidy (tested at various levels), a subsidy that varies with the price of crude oil, no subsidy, a two-part subsidy aimed at energy security and GHG reduction, and the Renewable Fuel Standard, also at various levels. Combinations of these options have also been examined. In terms of the modeling approach, we have moved from the firm-level analysis originally envisioned to a sector approach encompassing corn production and consumption, gasoline production and consumption, and ethanol production and consumption. The sector approach provides a richer framework for analysis. However, we still intend to produce the firm level results for the fixed and variable subsidy options to capture the stochastic analysis impacts from these options. Especially in the sector analyses, the models help to make clear the new integration of energy and agricultural markets. For example, corn and oil prices were weakly or not at all correlated in previous years. However, as oil prices increase, ethanol demand increases, producing greater demand for corn, which increases corn prices.

This connection between agriculture and energy also creates some interesting dynamics for public opinion. Dr. Wegener and a colleague recently analyzed public opinion data from late 2007 and early 2008. At that time, U.S. citizens were largely favorable toward biofuels and use of corn to produce biofuels. However, these attitudes were also associated with relatively little knowledge and should, from an attitude-strength perspective be vulnerable to “attacking” information that disagreed with those favorable opinions. Interestingly, the initial surveys were conducted before most reports of increasing food prices and the many subsequent news reports and editorials

linking increased corn prices to ethanol production. Thus, the public has received a series of "attacks" on their favorable views of ethanol (especially ethanol made from corn). We will be able to examine changes in public opinion in the next phase of our HSD research, which includes a broad survey of public opinion toward ethanol sources and associated policies.

These surveys will follow focus groups scheduled to begin in fall of 2008. In preparation for these focus groups, the political science and psychology members of the research team have reviewed existing research on public attitudes and beliefs about ethanol and alternative energy sources, have continued to meet with our colleagues in agricultural economics to ensure that our questions accurately reflect the policy options that are used in the economic modeling, and we have included other policy options that have not yet been used in our colleagues' economic models (e.g., cap and trade programs). We are close to pilot testing a two part instrument of closed and open ended questions for use in the focus group sessions later in fall of 2008.

Challenges and Opportunities:
Because this topic has become so important politically and economically, members of the research team have been able to leverage the NSF resources to obtain additional funding to greatly expand the economic modeling research. The economic analysis now will encompass global impacts of U.S. and E.U. biofuels policy alternatives. It will also be expanded to include biofuels production from cellulosic feedstocks.

The political and economic importance of the topic also contributes to an ever-changing public opinion landscape in which the timing of public assessments may influence the comparisons we would like to make (e.g., between the lay public and policy-makers). For the later laboratory decision-making research, however, any increases in knowledge of ethanol and ethanol production is more likely to result in attitudes that play a strong role in related decisions. This may make it easier to demonstrate various effects of ethanol-related attitudes on decisions.

Project Title: An Analytic Framework for Political and Social Change: Conflict, Beliefs, and Dynamics

Proposal Number: 0729361

HSD Emphasis Area: Dynamics of Human Behavior

PIs: Daron Acemoglu, Economics, MIT; Munther Dahleh, Electrical Engineering and Computer Science, MIT; Asuman Ozdaglar, Electrical Engineering and Computer Science, MIT; Devavrat Shah, Electrical Engineering and Computer Science, MIT

Project Goals:

- Developing an analytical framework for institutional dynamics.
- Systematic quantitative study of social belief formation.
- Investigation of interaction between political economy and beliefs.

Methodologies:

- Political economy models.
- Models of belief formation and social interactions.
- Quantitative models from control theory and statistical mechanics for the study of the evolution of social beliefs.

Research:

Our team has worked on a number of projects mentioned in the proposal. We have completed a number of papers on institutional change, including the paper by Acemoglu and Robinson, "Persistence of Power, Elites and Institutions," which is now published in the *American Economic Review*.

In addition, we have made significant progress on a number of projects related to the evolution of social beliefs in complex societies. A major part of this work is contained in the working paper, "Bayesian Learning in Social Networks," by Acemoglu, Fahleh, Lobel and Ozdaglar.

In two other related projects, additional aspects of belief formation in complex societies have been studied. These include the working paper "Social networks with(out) influential agents," by Dolecek and Shah, and the working paper "Spread of (Mis)Information in Social Networks," by Acemoglu and Ozdaglar.

All of these works were presented at Game Theory World Congress 2008.

Findings from Research to Date:

The work on institutional persistence provides a general and flexible framework for the study of changes in the de jure and de facto political power. In particular, it demonstrates how changes in formal institutions may be offset by investments in de facto power, providing a potential explanation for persistence of certain economic practices in the face of changing political institutions. It also delineates conditions under which political change will be effective in reforming economic allocations.

Our major work on belief evolution studies the (perfect Bayesian) equilibrium of a model of learning over a general social network. In this model, each individual receives a signal about the underlying state of the world, observes the past actions of a stochastically-generated neighborhood of individuals, and chooses one of two possible actions. The stochastic process generating the neighborhood defines the network topology (social network). The special case where each individual observes all past actions has been widely studied in the literature. We characterize pure-strategy equilibria for arbitrary stochastic and deterministic social networks and characterize the conditions under which there will be asymptotic learning - that is, the conditions under which, as the social network becomes large, individuals converge (in probability) to taking

the right action. We show that when private beliefs are unbounded (meaning that the implied likelihood ratios are unbounded), there will be asymptotic learning as long as there is some minimal amount of expansion in observations. We show that when the probability that each individual observes some other individual from the recent past converges to one as the social network becomes large, unbounded private beliefs are sufficient to ensure asymptotic learning. This result establishes that, with unbounded private beliefs, there will be asymptotic learning in almost all reasonable social networks. We also show that for most network topologies, when private beliefs are bounded, there will not be any asymptotic learning.

Other recent work show how in realistic models of non-Bayesian learning, misinformation may spread in the society (for example as a result of forceful agents, such as community leaders or news sources). We provide bounds on the influence of such misinformation on the long run belief distribution as a function of the interaction structure in the society.

Other recent work addresses the question of understanding the effect of the underlying graphical structure and opinion propagation on creating influence of individuals in a social network, where we consider both the discrete and the continuous nature of the propagated opinions. For the discrete case, our contributions are the proposal of a new natural model for information propagation based on the information-theoretic ideas, and the subsequent crisp characterization of influence of a given agent. In this model, the opinion may be sent intact or altered, depending upon the agents' own disagreement with the received opinion, where the amount of disagreement is given by the probability of alteration. In this setting, an agent is influential if other agents reasonably far away collectively agree with the original opinion. We consider both temporal sensitivity (when and agent only has time to hear an opinion once before forming its own) as well as temporal indifference (when an agent may hear opinions from multiple neighbors). For the continuous case, we extend the naïve update model, previously proposed by Golub and Jackson. Under this simple model, where agents form their opinions by taking weighted averages of their neighbors' opinions, we interpret influence in terms of the structural properties of the underlying Markov chain and positive recurrent states of such a chain. By combining the concepts from the information and percolation theory, interacting particle systems and the theory of Markov chains, we therefore characterize influence in a large society for various temporal constraints and opinion types.

Contributions Related to Education:
Acemoglu has continued to develop his graduate level course on political economy of institutions and development. This course is attended by over 30 graduate students from MIT, Harvard, Boston University and Brown. Recent research findings have been partially incorporated into the course.

Ozdaglar has continued to develop her graduate level course on game theory in the engineering school.

Project Title: The Process of Collective Behavior: Validation of a Unified Mathematical Model Using Computer Vision Tracking

Proposal Number: 0729363

HSD Emphasis Area: Dynamics of Human Behavior

Lead PI: R. Barry Ruback, Pennsylvania State University
Co-PIs: Robert Collins, Christopher Byrne and Yanxi Liu, Pennsylvania State University

Project Goals:
- An analysis of existing literature and data on the centrality of a small group focus for an understanding of crowd behavior
- Development of a mathematical model of collective behavior
- Development of computer vision tracking methods to detect and recognize clusters of individuals

Thematic Areas:
- Decision making and social influence
- Mathematical modeling of individual and group behavior
- Use of computer vision tracking of actual crowds to test and validate both (1) hypotheses derived from psychology and sociology and (2) mathematical models of individuals and groups

Methodologies:
- Traditional social science methods – survey, observation, experimentation
- Mathematical modeling and computer simulation
- Computer science

Recent Research Findings: We have been working toward determining the importance of small groups, developing mathematical models, and detecting individuals and groups through computer vision tracking.

1. *Importance of small groups.* Across a variety of situations, especially those conducive to social interactions, we find that people tend to arrive and leave in small groups. This conclusion is based on our compilation and analysis of studies involving 89,573 individuals at several different types of locations (e.g., restaurants, national parks, beaches), as well as analysis of data we have collected (e.g., examining 15,111 ticket purchases to concerts, shows, and other events , interviewing a systematic sample of 524 persons attending a political rally).
2. *Mathematical modeling.* Prior models of collective behavior have been of three types: rational choice models, particle models, and threshold models. Rational choice (game theory) models and threshold models govern decisions such as where a person would attempt to move, while particle models govern movement and incorporate physical constraints such as collision avoidance. Rational choice and threshold models incorporate alternative perspectives on decision making that we believe are valid under certain circumstances and should be integrated for a comprehensive theory of collective behavior.

Our strategy has been to first develop a particle model for motion, given exogenous decisions for the actors (agents), which will enable modeling of important properties relevant to our study. This year we developed a model that gives physical dimensions (height, radius and mass) to people and uses velocity-based avoidance criteria to model individuals' attempts to preserve personal space while seeking their goal (focal point). We will next focus on integrating the cognitive parts of our model that will make focal points endogenous and dynamic.

3. *Computer tracking.* We have been developing computer vision algorithms to automatically (a) detect people in video, (b) track them to measure their trajectories, and (c) identify small pedestrian groups by clustering people with similar trajectories.

3a) We have developed two pedestrian detection methods. The first detection method is based on "explaining" a foreground mask computed by background subtraction as a set of overlapping pedestrian shapes. The approach, implemented as a Markov Chain Monte Carlo sampler searching through the space of overlapping rectangular covers of a binary image, works well for low to medium crowd densities. To handle more dense crowds, we have developed a second method based on training a support vector machine classifier to locate the head and upper torso of pedestrians.
3b) We have developed two methods for tracking detected people in video. The first is based on using a variety of simple trackers to derive "tracklets" (i.e., short-term trajectories that are less likely to suffer from occlusion or tracking drift), which are grouped into longer trajectories based on principles of motion smoothness and curve continuity across gaps. A second tracking method, suitable for dense crowds, is based on the notion that crowds constrain the location of people relative to others around them. The Markov Random Field (MRF) formalism is a good model for representing such cases. The use of MRF with belief propagation (BP) as an inference engine provides a solid mathematical foundation for imposing spatial neighbor constraints into the tracking process. We have developed a faster version of BP called Mean-shift Belief Propagation (MSBP), which is between 30 and 50 times faster than either discrete BP or non-parametric BP for tracking 2D state-space problems, such as image locations of people.
3c) Our automated pedestrian and tracking method can extract trajectories from video and can detect small groups of people traveling together. In one study, we recorded one hour of video of more than 700 pedestrians. Three comparison standards were used to assess the validity of the computer vision technique: (1) the notes of two real-time observers, (2) coding by six independent raters, who identified pedestrians and small groups every 10 seconds of the video, and (3) interviews of every fifth pedestrian concerning whether they were alone or with others. The computer vision algorithm agreed with a composite of the six coders at a fairly high rate: 89% in terms of detecting people and 87% in terms of categorizing those individuals as alone or in a group.

Challenges and Opportunities:
We have had the opportunity to work with Penn State Police Services to film crowds as they entered and left an Obama political rally (more than 20,000 people) and three football games (one more than 70,000 people and the other two more than 106,000) using two digital video cameras mounted on the upper deck of the stadium.

Although we hope to make these and other datasets available to other researchers (including digitized archival footage of crowd behavior taken by McPhail during the 1960s and 70s), the sheer size of the data is enormous (we project that our football stadium taping this season will result in over 200 Gigabytes of digital video). A challenge for the future is to allow researchers to browse the raw footage on the web and download just the sections of interest to them.

Although our grant is focused on studying the small group structure of crowds, we are looking for opportunities to make our work more relevant to the immediate needs of campus and city police, as well as Homeland Security. For example, the automated tools we are developing for detecting and tracking people in video can be repurposed for use in counting people and identifying bottlenecks in pedestrian flow.

Project Title: Exploring the Determinants of Household Environmental Behavior: A Socio-Spatial Analysis of Lawn Care Practices

Proposal Number: 0729387

HSD Emphasis Area: Agents of Change

Lead PI: James Fraser, Vanderbilt University
Co-PIs: Larry Band, University of North Carolina at Chapel Hill; Morgan Grove, University of Vermont

Project Goals:

- This study investigates spatial and social patterns and controls of residential lawn care behavior specifically examining the following questions:
- How are household environmental behaviors spatially distributed?
- How are they related to household-level versus neighborhood-level socioeconomic and biophysical factors?
- How do neighborhood social dynamics affect household environmental behaviors?

Thematic Areas:

- Manage profound and rapid change, and make decisions on the face of changing risk and uncertainty (e.g. with relation household impact on watershed health.
- Understand the dynamics of human and social behavior at all levels. In this project we scale these behaviors from the household, to residential community and municipality.

Methodologies:

- household and organizational surveys and telephone interviews
- soil sampling
- high resolution image analysis of residential patterns
- analysis of census and commercial demographic and consumption information

Overview of work completed:
Our study examines multi-scaled determinants of parcel level environmental management. The work leverages on smaller previous studies as part of the Baltimore Ecosystem Study, and expands the analysis to order of magnitude larger survey size more diverse geographies and their interaction with local scale municipal governance as well as neighborhood-based governance. The research has particular significance for the city of Baltimore, as it is part of the Chesapeake Bay watershed, and in terms of neighborhood and demographic dynamics. We concentrate on lawn care practices that have been targeted as potential non-point source pollutants, and for private and neighborhood level behavior for significance to community formation and structure. In this sense we integrate ecosystem and hydrologic studies with community structure to form a synthetic approach toward urban ecology.

Work to Date:
Work during the first year has been done preparing for and carrying out household surveys and GIS analysis. Both efforts benefit from previous work in the Baltimore Ecosystem Study (BES, www.beslter.org) through previous household sampling (in person interviews, telephone interviews and synoptic description), comprehensive geodatabase development, outreach and collaboration with community and local government groups.
Geodatabase development

We have integrated and built upon previous geodatabase development in the BES to provide a rich information source to develop our sampling plan and as a framework for spatial analysis. Our geodatabase is developed within ArcGIS, and includes the following data layers most relevant to our study;

- Detailed land cover developed from high resolution imagery and lidar from (Xiao et al 2008) which provides detailed information on lawn extent
- Detailed hydrography from Baltimore County
- Parcel information from Maryland PropertyView
- PRIZM derived life style indicators and associated commercial consumption data (Grove et al 2006)
- Road networks and impervious cover
- Baltimore City neighborhood boundaries and characteristics (www.bnia.org)
- Census block, block group and tract information for 2000 and past census
- Other detailed biophysical and socioeconomic information

Household sampling
Our original sampling design was to sample households in subdivisions (Baltimore County) and neighborhoods (Baltimore City) stratified by census blocks. Initial GIS analysis showed that large subdivisions, at times, span multiple census blocks, requiring a modification to our sampling plan. A nested sampling design has been developed within which census blocks are first stratified by socio-economic status and housing age, both variables we have previously shown to be important in lawn care practices.

Household sampling was been completed August 2008. As part of the survey design, stratified samples were chosen and household addresses were generated within block groups. In Baltimore County, each property is coded with the subdivision (when the property is part of a subdivision). There were no sub-divisions in Baltimore City, but the City is divided into official neighborhoods, often with a neighborhood association. GIS overlay of the neighborhood map with parcels provided the sample of parcel addresses. Mailings to all potential households were sent out a few days prior to the survey. Each address was transferred to Google Earth to aid in neighborhood navigation and verification of sample size. Following survey visits, the number of positive and negative responses were recorded and maintained in order to track the response rate to assure adequate sample sizes. These were also transferred to Google Earth to aid in the sampling process. Post-interview, all field notes were typed by interviewers and maintained in an integrated database including scanned, completed surveys, consent forms, photographs, field notes, and audio recordings of the interviews. The recordings will be transcribed into digital text for subsequent qualitative analysis this coming year.

At present ~500 household surveys have been completed using 3-4 teams of surveyors including support personnel for digital information recording and distribution. In each team of three, one person was responsible for conducting the interview, one person for field note taking during the interview and one for measurement, identification and rating of lawn composition (grass cultivars, presence of shrubs, gardens, etc.) and areal measurements. Photographic documentation with geo-location was recorded for each property for further analysis and corroboration of visual inspection.

Next Steps
As part of the sampling process, periodic feedback is gained from the survey team by discussion and written response to specific questions posed and collated by the PI. These questions and discussion are designed to identify any important strengths or weaknesses of the survey instrument as well as emerging themes and trends. This information will be used as potential touchstones for the next round of interviews with subdivision and neighborhood association officers (See Appendix A).

Preliminary analysis of emergent spatial pattern of lawn care practices association with biophysical and socioeconomic information will be conducted in ArcGIS with subsequent and more detailed analysis done in R. Initial results will be presented at professional meetings

including the Association of American Geographers Annual Meeting in Las Vegas, Nevada in spring of 2009.

Appendix A: Project Reflection Topics
In groups of three please discuss the following topics and have one-person type up notes. Thinking about all of the interviews/households you have collected data on, discuss and record the following:

1. How do people connect their lawn/yard (care) to being part of a neighborhood?
2. How do neighbors influence each other's lawn/yard (care)?
3. What are the ways that people connect their lawn/yard (care) to knowing themselves and their neighbors?

Next, thinking about the ways in which neighborhoods are governed:
4. How do people describe the ways in which neighborhood residents/organizations set norms or guidelines for lawn/yard (care)?
5. How do residents/organizations put pressure upon people to maintain a certain lawn/yard aesthetic (look)?
6. How did interview respondents talk about neighborhood lawn/yard (care) norms and guidelines?

Drawing on these two sets of questions:
7. What social factors shape the way in which people perform lawn/yard (care), and how does this relate to fertilization and pesticide use?

*Last, recall three or four memorable interviews with people as it relates to lawn/yard (care). Write-up these stories in one long paragraph each so we can have a discussion and record of these events.

Project Title: DHB Testing a Dynamic Theory of Emotion using Infrared Imaging

Proposal Number: 0729396

HSD Emphasis Area: Dynamics of Human Behavior

Lead PI: Dawn T Robinson, University of Georgia
Co-PIs: Jody Clay-Warner, Chi Thai, University of Georgia and Kevin McCully, University of Georgia

Project Goals:

- Develop new, socially unobtrusive, and temporally sensitive measures of emotions experienced during social interaction using infrared thermography to measure changes in blood flow patterns on the face.
- Refine these thermographic measures and validate against other known emotion measurement techniques – including survey instruments, heart rate, blood flow, peripheral skin temperature, and skin conductance.
- Use these new measures to experimentally test affect control theory predictions about emotion sequencing in social interactions.

Thematic Areas:

- emotion
- social interaction
- measurement

Methodologies:

- experiments
- theoretically driven computer simulations
- infrared thermography and other psychophysiology measures

Recent Research Findings:
Much of the first six months of this project was spent purchasing new equipment and software, and doing the wiring, installation, and programming necessary to prepare the lab for the new series of studies. In addition, we conducted pilot research with an older camera to begin to investigate the rough relationship between facial temperature and emotional response.

First, we investigated how infrared images are affected by ambient temperature and backdrop. Because thermographic images are visual representations of heat, it is vital that heat being measured is coming from the intended source (i.e., a research subject). Because the image is a two-dimensional rendition of three-dimensional space, objects behind the intended target object may influence the thermographic map of that target object. Another concern is the residual heat left by an object once it is removed from the camera. This heat may be retained by walls or other backdrops. To determine how ambient heat and backdrop color affects the thermographic images, we measured the temperature of different areas on the thermographic image using a variety of backgrounds and in proximity to a computer screen using a number of color palettes. We found that some backdrops (e.g., cardboard) did retain a certain amount of heat from a face once that face was removed from the camera's view. We also measured the temperature of one spot on the image to see if any changes were evident when a computer monitor was situated in close proximity to the object of interest. The monitor did not affect the temperature of the object as measured by the infrared camera. We concluded that research participants should be situated in front of the camera with several feet of blank space behind them. This prevents heat from a backdrop from being detected or retained once an object is removed.

Next, we began investigating the ability of facial thermography to distinguish positive and negative emotion. In an experimental study (N=114), we manipulated positive and negative affect

using feedback with known response properties and included a control condition in which we measured affective responses just prior to the feedback (which was slightly delayed). Participants delivered a speech to an unseen rater and then received (contrived) feedback on their social skills. We examined thermal changes in four regions of the face (forehead-*corrugator*, eyes-*ocular/periocular*, cheeks-*zygomatic* major and minor, and mouth-*orbicularis oris*). Data analyses revealed the importance of accounting for both between subjects and within-subjects variation in facial temperature. We learned that the mouth cools dramatically *during* speech (due to the mechanical action of the lips being cooled by air flow) and warms again afterward – regardless of condition. This effect must be accounted for in order to usefully interpret affective response in the *orbicularis oris* region. We also encountered substantial individual variation in facial temperature in all four regions– which must be accounted for in order to meaningfully interpret systematic responses to stimuli.

Three key findings emerged from this experiment: (1) The mouth region cools with positive feedback and its temperature negatively correlates with reported positive affect; (2) The eyes warm with evaluative feedback of either type; and (3) The cheeks warm with negative feedback and their temperature positively correlates with reported negative affect. The brow warmed with both positive and negative feedback, but these changes were not statistically significant. Overall, these initial findings are promising in their suggestion that thermal facial patterns may distinguish between different emotional states.

Challenges and Opportunities:
The FLIR ExaminIR software used to control the new camera and to record the thermographic data was released in June, 2008. With the new software we purchased an SC4000/6000 camera with extremely fast frame rates – which enables 126 frames per second at a 640 x 512 focal plane array. This is a marked increase in data precision over that achieved by the camera used in our earlier research, and drastically increases the data handling and storage needs. Our initial trials with the camera revealed some important hardware and software issues to be resolved. Using the same data sampling protocols we employed with the older camera, our first experiments with the new camera overwhelmed the computers being used to acquire and store the pixel data. Because we are ultimately interested in looking at affective responses over the course of longer social interactions, we have been analyzing data from the earlier study as well as new pilot sessions to get a better understanding of how quickly regions of the face warm and cool in response to affective changes. This will allow us to optimize the data sampling so that we can collect data over longer periods of time without critical data loss.

Greater restrictions in thermographic data sampling also have led to a desire for more precision in the synchronization of thermographic data with data from other physiological measures. Consequently, we created a new hardware setup and programmed software to synchronize data streams coming from the instruments measuring peripheral skin temperature, blood flow and skin conductance, with the experimental stimuli, and with the thermographic pixel data. This hardware and software setup is now complete and we are ready to begin the first experiments with the new camera.

Project Title: Dynamic Patterning in Conflict Behavior Between States and Non-State Actors

Proposal Number: 0729405

HSD Emphasis Area: Agents of Change

Lead PI: Mark Crescenzi, University of North Carolina
Co-PIs: Robert Jenkins and Charles Kurzman, University of North Carolina

Project Goals:
In broad terms, our research concerns the question of when and why states and non-state actors find themselves in violent political interaction versus non-violent bargaining and negotiation. Within this context, we are pursuing the following three research goals:

- Do non-state actors experience direct and indirect (reputational) learning with respect to their interactions with states, and does this learning have an impact on the occurrence of violence between state and non-state actors?
- Does the existence/degree of fractionalization within non-state groups as well as state governments inhibit this ability to learn, both in the spatial sense and in the dynamics of interaction over time? Is there an internal structural context within actors that facilitates or inhibits learning?
- Does the existence/degree of dynamic patterning over time lend itself to learning opportunities? Moreover, are there critical "deinstitutionalized" moments when these patterns break down and previous learning patterns unravel?

Thematic Areas:

- Political Science, Conflict Processes, Conflict Management and Peace Science
- Sociology, Social Movements, Revolutions
- International and Civil Conflict, State Repression, Conflict Dynamics

Methodologies:

- Our principal approach employs event level data that is then assessed using event history and time-series techniques.
- The event data comes from the TABARI project, focusing on the Levant. This focus allows us to concentrate on a well-known set of state and non-state actors with a set of events that is well covered.
- When we move into the analysis phase of the project, we will implement event history (survival) models to examine the risk of violence. We also plan to implement time-series models such as vector auto-regression to capture the endogenous dynamics of the state—non-state actor relationships over time.

Recent Research Findings:
Since this project is still in its first year of activity, the majority of our efforts are focused on the data collection and processing activities. In this case, we are working with the raw TABARI Levant events data set, a machine coded events data set focused on the Middle East.

From this larger population of events we are focusing on the event dynamics within and between Israeli and Palestinian actors. We are currently examining a subset of these stories that do not contain specific actor designations beyond Israel or Palestine. Since TABARI focuses on lead stories from wire feeds to generate events data, we are examining the extent to which deeper coding rules will improve the specificity of these events. This data preparation will allow us to better assess the impacts of fractionalization and reputation in the learning process.

We have also begun preliminary assessments of the dynamic patterning hypotheses. Our research shows that dynamic patterns do emerge as tight reciprocity processes. A typical pattern

emerges to include rapid reciprocity behavior. We are currently working to parse out this short-term reciprocity pattern in search of larger (long/medium-term) pattern dynamics.

Challenges and Opportunities:
We see important opportunities emerging from this project. First, we will be able to demonstrate the learning dynamics between state and non-state actors in a systematic fashion. As the fields of conflict processes and peace science increasingly focus on the internal spatial dynamics of nations (sub-state actors, particularly with respect to civil wars), our focus on the temporal dynamics provides an important complement for integrated future research. Second, our synthesis of dynamic behavior, structural context and environmental context provides a template for understanding adaptation in political conflict.

One challenge continues to be working with event level data. While the data provide the appropriate structure for our dynamic analysis, the noise, bias, and coverage issues of the data must be controlled for before analyzing the data. Further, the lead-sentence structure of the TABARI software, while largely sufficient for state data and the more established non-state actor data, may miss some of the sub-actor specifics that would allow us to examine the role of fractionalization in learning dynamics.

Project Title: Modeling Interactions Between Individual Behavior, Social Networks and Public Policy to Support Public Health Epidemiology

Proposal Number: 0729441

HSD Emphasis Area: Dynamics of Human Behavior

Lead PI: Madhav Marathe, Virginia Tech,
Additional PIs: Martina Morris, (University of Washington) and Josh Epstein (Brookings Institute)
Co-PIs: Christopher Barrett, Stephen Eubank, Richard Beckman and Anil Vullikanti (Virginia Tech)
Senior Investigators: Keith Bisset and Achla Marathe, (Virginia Tech) and Ross Hammond (Brookings Institute)
Consultants: Prof. Nosh Contractor (Northwestern University)
International Consultants: Prof. Peter Hedstrom (Oxford University), and Prof. Vega-Redondo (European University Institute, Florence)

Project Goals:

- Develop high fidelity computational models for understanding the aggregate effects of interactions among individual behaviors, social contact network and public policies
- Incorporate the effects of these interactions in planning and responding to such threats such as infectious disease outbreaks
- Develop rigorous mathematical and computational theory of graphical games and Markov Decision process as it pertains to public health epidemiology

Thematic Areas:

- Computational agent based models
- Dynamic Social networks and individual behaviors
- Public Health Epidemiology

Methodologies:

- Computational agent-based models of individual behavior and its interaction with social networks and public policy
- Theoretical investigation of the dynamic co-evolution of social networks, individual behavior and public policies using game theory and graphical co-evolving discrete dynamical systems and stochastic optimization of the
- Illustrative realistic case studies that demonstrate the results of our research to aid in planning for and responding to large scale infectious disease outbreaks

Recent Research Findings:

Research undertaken by the team spanned a number of topics in high performance computing, social science, public policy and public health epidemiology. Behavioral adaptation in epidemics is virtually ignored in mathematical modeling of infectious disease. These adaptations, which may be far from fully informed or rational will endogenously change network structure, and in turn, affect contagion dynamics. Moreover, realistic models often do not scale, motivating the need to develop high performance computing based simulations to understand this co-evolution. Team members have carried out research in both these topics; the work has resulted in a number of peer-reviewed publications. The integration of these lines of work will be a major advance in large-scale modeling and is a central objective going forward.

- Developed high performance computing based simulations for studying the spread of infectious diseases in large urban neighborhoods; system is shown to scale to 10+ million individuals residing in urban regions of the size of Chicago. (results to appear in Proc. ACM/IEEE Supercomputing'08).

- Developed a mathematical model to capture co-evolution of individual behavior, social network and disease dynamics. The results appear in: (*i)* Proc. Annual Conference of AAAI'08 2008, (*ii*) DIMACS/DyDAn Workshop on Computational Methods for Dynamic Interaction Networks, 2007, and (*iii*) Chapter in the book titled "Fundamental Problems in Computing: Essays in Honor of Professor Daniel J. Rosenkrantz," S. Ravi and S. Shukla (eds.), Springer, to appear, 2009.
- Preliminary work on the theoretical and experimental analysis of graphical game theoretic models arising in public health epidemiology. The framework was used to study vaccination decisions, when vaccines are imperfect, and can induce risky behavior, such as increased contacts. We found that for such games Nash Equilibria need not exist in general and there can be a huge variation in the social cost associated with these equilibria. Furthermore, their characteristics are sensitive to the amount of local information available for making decisions.
- Preliminary work on developing agent based models to understand individual behavior from an economic perspective. Specifically we study the prevalence elasticity of private demand for prevention against the pandemic flu. We study how different interventions perform in terms of their economic as well as social impact. The work was motivated by a recent NIH sponsored study described below.
- In a recent paper, titled "Coupled Contagion Dynamics of Fear and Disease: Mathematical and Computational Explorations." (submitted to PLOS_1). In the paper, we model two interacting contagion processes: one of disease and one of fear of the disease. Individuals can "contract" fear through contact with individuals who are infected with the disease (the sick), infected with fear only (the scared), and infected with both fear and disease (the sick and scared). Scared individuals--whether sick or not--may remove themselves from circulation with some probability, which affects the contact of individuals and thus the disease epidemic proper. If we allow individuals to recover from fear and return to circulation, the coupled dynamics become quite rich, and include multiple waves of infection. We also study flight as a behavioral response
- Another behavioral factor that shapes dynamics is assortative mixing--where contacts are more likely among certain groups or strata than between them, This results in spatial clustering, which affects contagion and the prospects of various containment strategies. Specifically, Senior Investigator, Hammond has developed an agent-based model with clustering and finds that it can dramatically increase incidence. He explores the effect under a variety of assumptions about intervention efficacy, disease characteristics, and social compliance rates.
- The Brookings Center on Social and Economic Dynamics won the 2008 NTSA Award for Outstanding Achievement in Analysis for our Large-Scale Agent Model (LSAM). PI Epstein directs CSED, and Co-PI Eubank is a CSED Fellow. The LSAM is an individual-based model that simulates nationwide US contact dynamics with 300 million individuals displayed on a zip-code resolution map including workplaces, schools, and households replicating the US Census. It allows very detailed epidemic simulations, and has been extended to include the behavioral adaptations noted under the two preceding bullets above.

Challenges and Opportunities:

During the course of our investigations, we had an opportunity to work on an NIH sponsored project analyzing several proposed antiviral distribution schemes for HHS.

This work was undertaken jointly between Virginia Tech and Brookings Institute. We compared the potential public good of inducing herd immunity in the event of an influenza pandemic to the inescapable inequities produced by income-based distribution schemes, including the effect an outbreak might have on antiviral uptake. Results of this analysis influenced HHS policy. This project provided an excellent user driven case study; the methods were jointly developed with support from NIH, DoD and NSF work. The NIH study has motivated us to further investigate economically inspired individual behavior and stochastic optimization problems as they relate to "optimal strategies" for allocating antivirals and vaccines for pandemic preparedness. It has also

given us insight into requirements sophisticated models of co-evolving networks must meet if they are to guide policy.

Project Title: Designing Resilience for Communities at Risk: Decision Support for Collective Action under Stress

Proposal Number: 0729456

HSD Emphasis Area: Decision Making, Risk, and Uncertainty

Lead PI: Louise K. Comfort, Graduate School of Public and International Affairs, University of Pittsburgh
Co-PIs: Daniel Mosse, Department of Computer Science, University of Pittsburgh; Rami Melhem, Department of Computer Science, University of Pittsburgh
International Partners: M. Syahril Badrik Kusuma, Bandung Institute of Technology, Bandung, Indonesia; Harkunti Rahayu, Bandung Institute of Technology, Bandung, Indonesia; Idwan Suhardi, Ministry of Science & Technology, Jakarta, Indonesia

Project Goals:

- Inquire into the interdisciplinary problem of collective action in communities exposed to recurring risk
- Explore methods and models for enhancing the capacity of a community to assess and respond to shared risk with the innovative use of information technologies
- Assess information requirements for a community-wide information system that addresses four primary decision points: 1) detection of risk; 2) recognition and interpretation of risk for the immediate context;3) communication of risk to multiple organizations in a wider region; and 4) self organization and mobilization of a collective, community response system to reduce risk and respond to danger
- Implement and evaluate a computational model of decision support for early tsunami detection in the testbed community of Padang, Sumatra, Indonesia with the collaboration of Indonesian colleagues at Bandung Institute of Technology, Bandung and the Ministry of Science and Technology, Jakarta, Indonesia

Thematic Areas:

- Communication and coordination of action among organizations and between jurisdictions in risk environments
- Design, implementation, and evaluation of socio-technical systems to support collective action in risk environments
- Identification of cross-cultural thresholds for organizational learning and action

Methodologies:

- Network analysis to identify the interactions between organizational and technical systems engaged in the assessment of, and response to, risk in regions exposed to tsunami hazards
- Computational design of ‘semantic domain views’ in urgent environments
- Computational modeling of sociotechnical strategies to support collective action in risk environments

Recent Research Findings:

This first project year has been focused on building a carefully constructed knowledge base for early tsunami detection and warning systems, with particular attention to the geography, geophysics, policy, and cultural context of Indonesia. Four primary findings emerged from this literature search and review. They include: 1) assessment of current scientific progress in measuring and monitoring tsunami risk; 2) identification of gaps in current programs for improving performance in detecting, measuring, and monitoring tsunami risk; 3) identification of methods of linking networks of technical sensors to networks of organizational actors to improve performance in monitoring and managing tsunami risk in communities exposed to coastal hazards; and 4) tsunami preparedness and education programs in the Indian Ocean Basin and Indonesia.

The principal findings from the interviews, field observations, and literature review conducted during this first project year essentially confirmed the relevance of the research questions that were identified for this project, with its focus on near-shore tsunami risk. It also underscores the potential contribution of the design of a network of low-cost sensors that can transmit data in a form that practicing emergency personnel can grasp quickly and translate into timely, effective action.

Challenges and Opportunities:
The second project year will build on the cumulative knowledge base developed during this first project year to design a computational simulation of a decision support system that will transmit the scientific data from a network of undersea sensors to a network of land-based organizations in a format that is readily understandable to emergency managers with a range of training and experience. Computational simulation offers a means of developing and testing a model for this difficult task, which has not been done in prior research, without heavy investment in equipment or personnel training.

The third project year will implement and test the computational model of early tsunami risk detection in a testbed exercise with emergency response personnel and organizations in Indonesia. Participation in an actual disaster preparedness exercise in Indonesia creates both the opportunity and the challenge to determine whether the model would meet the anticipated demands of early tsunami detection and response. The performance of the model will be evaluated by experienced personnel from public, private, nonprofit, and scientific organizations in Indonesia and from other international agencies.

Project Title: Integrating Agent-Based Modeling and Life Cycle Analyses to Enhance Environmental Policy-Making

Proposal Number: 0729458

HSD Emphasis Area: Decision Making, Risk, and Uncertainty

Lead PI: Christopher Ruebeck – Lafayette College
Co-PIs: Sharon Jones, Jeffrey Pfaffman, Kristen Sanford Bernhardt – Lafayette College
Outside Collaborator: Jackie Isaacs – Northeastern University

Project Goals:

- Create a framework for environmental policy that incorporates product markets.
- Model the complex interaction of heterogeneous stakeholders: the interaction between market participants and with the policy maker.
- Disseminate these techniques in the literature and as software tools.
- Integrate the methods and findings in undergraduate interdisciplinary education on the subjects of sustainability, stakeholders' incentives and their strategic interaction, and computational methods.

Thematic Areas:

- Environmental policy
- Economics of markets and strategic interaction (game theory)
- Computer modeling and simulation
- Sustainability
- Undergraduate literacy in interdisciplinary issues

Methodologies:

- Agent-based modeling (ABM) with Repast, NetLogo, "homegrown" design tools
- Aggregation of life-cycle analysis (LCA) studies
- Flexible software on CPU cluster for
    - describing models as software structures and
    - implementing a variety of techniques for searching parameter spaces
- Validation using data from case studies with three distinct market structures: shipping pallets, cell phones, and water delivery systems
- Use of simulation to teach sustainability, strategic interaction, and ABM

Recent Research Findings:

Finishing the first year of our study, we thus have not yet produced conclusive findings. We have, however, made significant progress on our goals. Progress to date includes:

- We have collected and evaluated LCA studies on cell phones and water delivery systems in addition to our aggregation of shipping pallet LCA studies.
- The cell phone LCA aggregation document has been prepared, accepted at an international sustainability conference, and is under preparation for publication.
- The shipping pallet study, which also employs a simple game theoretic model, is under revision for publication.
- An ABM computational infrastructure is under development implementing an existing agent-based model from the literature to create an environment for model investigation, parameter space searching, and verification & validation of results.
- The CPU cluster will be installed within the next two months for implementation of our computational infrastructure and parallel processing methods.
- Our models of the markets are under development as two simple NetLogo implementations of the shipping pallet market and as a general conceptual structure for the cell phone market and the shipping pallet market.

- We are collaborating on a white paper to fully specify the interaction of shippers, receivers, and third-party repairers/recyclers in ABM simulation.
- Calling repairers/recyclers listed in the Yellow Pages or on the National Wood Pallet Container Association's web site accomplished a preliminary market research study of parameters for the Pennsylvania shipping pallet market.
- Two visiting scholar seminars have drawn attendance from across the science, social science, and engineering divisions on campus. The fall 2007 seminar presented results in agent-based modeling, and the spring 2008 seminar covered timely life-cycle analysis issues. We have scheduled the fall 2008 visiting scholar seminar, on agent-based modeling and environmental policy; the coming spring 2009 seminar on agent-based modeling is in the planning stage.
- The undergraduate research assistants that are not computer sciences majors have been trained in computational methods through a course in computational methods developed under a complementary NSF grant.
- Team members (both faculty and students) are learning about the other disciplines' methods and techniques—through meetings one-on-one with students, between the faculty members, and with the entire group. We have also held mini-seminars for the group on agent-based modeling and market structure.
- We are working with Jackie Isaacs and her collaborators on a simulation project called Shortfall that teaches sustainability, funded through NSF grants.
- We have set up a web site for documents, schedules, and other resources that are being shared by and discussed among the faculty and student group members.

Challenges and Opportunities:

- While we were putting together the NetLogo simpler implementations of our previous shipping pallet model, the white paper specifications took on significant complexity. Our challenge is to find simplifying assumptions that best capture each market without sacrificing relevant richness in stakeholders' characteristics.
- Due to new responsibilities taken on by one of the original co-PIs, we have now taken on an additional team member with whom we had previously discussed interdisciplinary ABM strategies, projects, and philosophy.
- Integrating the goals for the interdisciplinary team has educated each of us in the challenges of understanding the other disciplines' perspectives.

Project Title: Scalable Computational Analysis of the Diffusion of Technological Concepts

Proposal Number: 0729459

HSD Emphasis Area: Dynamics of Human Behavior

Lead PI: Ping Wang, University of Maryland, College Park
Co-PIs: Douglas W. Oard and Kenneth R. Fleischmann, University of Maryland, College Park

Project Goals:

- We aim to understand the dynamic social system through which certain innovation concepts come to dominate the information technology (IT) field whereas others do not. Specifically, how do the actions and opinions of individuals and organizations give rise to popular concepts in IT and how do such dynamics change over time?
- We also aim to integrate computational analysis of text with theory building and testing in social science research. Specifically, we develop an iterative process in which computational analysis of text is used to populate a model of salient aspects of social dynamics. Interpretations based on that model will then be used to guide refinement and enrichment of the computational analysis.

Thematic Areas:

- Everett M. Rogers defined an innovation as "an idea, practice, or object that is perceived as new by an individual or other units of adoption." We argue that each innovation can take on a *concept* form and a *material* form. The concept form of an innovation refers to the set of ideas about the development and use of the innovation. The material form of an innovation refers to the existence of the innovation in the physical world, often as artifacts and practices. Thus far, innovation research in various social science traditions has given relatively little attention to the concept form of innovations. However, as innovation concepts can be adopted potentially by social actors far more diverse than those adopting material innovations, it is important to understand the social dynamics for diffusing innovation concepts.
- Coming from diverse social worlds, social actors engage in discourse to exchange ideas about an innovation. The innovation concept serves as a *boundary object*, which helps to bridge the diverse values and norms of the actors within different social worlds. In a dynamic micro-macro process, the innovation concept summarizes specific social actors' specific ideas about an innovation, travels from one social world to another, and gets translated into specific ideas by specific social actors.
- Given the significance of technological innovations in our economy and society and the important functions technological concepts play in shaping the diffusion of the innovation products and services, the diffusion of these concepts themselves warrants more research. We therefore undertake this research to *describe*, *explain*, and *predict* the diffusion of technological concepts.

Methodologies:

By coupling focused extraction and classification for high-volume multi-source data with a multi-concept computational analysis strategy, the project creates a new middle ground between today's richly analyzed but narrowly focused case studies and the presently available scalable but relatively shallow techniques, such as citation analysis. We offer an overarching framework for theory development and empirical testing. Specifically, guided by a broad theoretical framework, we collect data and select features of the data to conduct a scalable computational analysis, in order to explore interesting hypotheses raised in previous qualitative case studies. By scalable, we mean that our analysis can be easily expanded to include more concepts, more factors, and from more sources as needed. We feed the findings from our analysis back to a new round of qualitative case studies, which inspires another round of computational analysis. We call this general methodological framework "theory-based case-computation iterative inquiry."

Recent Research Findings:

- Our longitudinal case studies on ERP (enterprise resource planning), CRM (customer relationship management), and BPR (business process reengineering) using "found data" (topic labels assigned to trade press articles by human indexers) that is available in substantial quantity found that (1) cues in the environment such as business problems are positively related to the popularity of a focal innovation, (2) innovations that are similar in their content are competing for social attention, and (3) leading knowledge entrepreneurs promoting or denouncing innovations change during the course of an innovation's life cycle. This set of case studies defines a strong baseline with which automated techniques can be compared.
- Automatic classification experiments with this same label set indicate that a committee-of-classifiers design is well matched to the task, and that hierarchical classification based on agglomerative clustering of labels with empirically similar usage yields further gains. Intrinsic evaluation using F1 and accuracy indicate that replication of human indexing is more accurate for specific concepts (e.g. ERP) than for broad concepts (e.g., software), which should not be a significant limiting factor since our present focus is on narrower concepts. Serendipitously, one collection of substantial size was manually indexed independently by two sources (using different classification schemes), which provides an opportunity for replication of these experiments, which is presently underway.
- As exploratory work to support a potential international collaboration (described below), we have investigated integration of classification models with statistical translation models to simultaneously identify specific topics in English and Chinese texts based on manual labeling of a limited number of documents in each language. Our results, on paragraphs from news stories in each language, indicate that balanced training (some in each language) can yield greater classification accuracy than an equivalent amount of single-language training.
- Applying our classification algorithms to very large collections of news, blog, trade press and academic journal collections will require massively scalable computational implementations for both term-based indexing and for recognizing similar term usage. We have accelerated this development effort before completion of our first round of content harvesting by constructing a simple challenge problem: compute the similarity between each of the 821-billion possible document pairs in the 906,000-document AQQAINT collection of news stories. Our efficient mapping of this problem onto the Hadoop implementation of Google's MapReduce infrastructure for massively parallel text processing required just over two hours on a 20-machine cluster. We now have access to a 120-node Hadoop cluster (thanks to IBM and Google for providing the resources).
- Results from this work have been reported or are forthcoming in the *Journal of the Association for Information Systems*, *Information Technology and People*, and at the *International Conference on Information Systems (ICIS)*, the annual conference of the *American Society for Information Science and Technology (ASIS&T)*, the annual conference of the *ACM Special Interest Group on Information Retrieval (SIGIR)*, and the annual conference of the *Association for Computational Linguistics (ACL)*.

Challenges and Opportunities:

- Although the information industry, and in particular large content aggregators, is not yet configured to support scalable computational access to their content to large number of researchers, we have found considerable interest in exploring partnerships that may help to address that issue in the future. In particular, ProQuest (providers of the widely used ABI/INFORM databases) has worked with us to explore the potential for API-based access; this collaboration included regular participation by ProQuest research staff in some of our project team meetings, and a ProQuest internship for one of our graduate students in Summer 2008.
- We have met with researchers at the National University of Singapore to explore the potential for collaboration to extend out techniques to analyze global diffusion of IT

innovations using large collections of temporally and thematically comparable content in English and Chinese.

Project Title: Dynamics of Space and Time Use: Patterns, Causes, and Consequences for Crime and Problem Behaviors

Proposal Number: 0729466

HSD Emphasis: Dynamics of Human Behavior

Investigators: Ruth D. Peterson (Lead PI, Sociology), Christopher Browning (Sociology), Catherine Calder (Statistics), Lauren J. Krivo (Sociology), Mei-Po Kwan (Geography); Ohio State University

Research Goals

This research seeks to increase understanding of how criminal and other problem behaviors are affected by the different neighborhood environments that people move through during the course of their daily lives, and to determine whether these influences operate in the same manner for individuals of different ages. Existing studies have shed some light on the ways that neighborhoods affect crime and other related problems, but have used a narrow definition of neighborhood environment that only includes the local area in which people live. This project recognizes that human social interactions do not take place at one time point and are not wholly contained within neighborhoods of residence. Rather, people move through a variety of dynamic local environments as they carry out their regular activities of: going to work and school; securing child care and health care; and engaging in informal socializing and religious activities. These dynamic patterns of activity among people and communities produce more or less *social isolation*, which in turn, affects crime and other problem outcomes among young persons and adults. In brief, neighborhood environments are themselves dynamic and are influenced by other neighborhoods, which may or may not be geographically proximate. Drawing on these ideas, the project seeks to: (1) provide a theoretical model of the meaning and consequences of social isolation; (2) develop corresponding measures of individual and neighborhood social isolation by combining unique space- and time-use (i.e., activity pattern) information from the L.A. Family and Neighborhood Survey (L.A. FANS) and state-of-the-art Geographic Information Systems (GIS) technology; (3) use these geospatial measures to describe differential patterns of social isolation across various demographic and social groups and neighborhood types; (4) evaluate the relationship between spatial segregation and social isolation; and (5) use information from L.A. FANS and the National Neighborhood Crime Study (NNCS) to explore the consequences of individual and neighborhood social isolation for crime, delinquency, and problem behaviors at different points in the life course using multilevel statistical models.

Substantive Accomplishments to Date

The project has only been underway since January 2008. Thus, much of our time has been devoted to staffing the project, exploring the complex L. A. FANS restricted data, and identifying appropriate information for operationalizing key individual and neighborhood variables for our planned analyses. As a result, we have only a few very preliminary findings to report at this point. However, we are making progress on a number of substantive fronts.

The Meaning and Consequences of Social Isolation. As noted above, one goal of this project is to define the meaning and consequences of social isolation. Toward this end, we have performed various exploratory analyses. These preliminary analyses and others not mentioned here have guided our research by helping generate hypotheses and highlighting factors we will account for in future analyses.

A large portion of our exploratory analyses have centered on comparing characteristics of individual L.A. FANS participants' residential census tracts to the characteristics of census tracts where the individuals spend considerable time, such as the workplace and third location (defined by L.A. FANS to be the location other than home and work that a person visits most often). Using numerical and graphical summaries, we examined the distributions of and associations between

various neighborhood characteristics (e.g., concentrated disadvantage, racial composition) across the residual, workplace, and third locations of the adult participants. These summaries allowed us to explore whether, for example, individuals tend to live and go to places that are similar with respect to these characteristics. In addition, we examined whether the observed relationships between residual, work, and third location at an aggregate level hold for subpopulations (e.g., members of a specific racial/ethnic groups). One preliminary finding of interest is that for most individuals the census tract of residence is more similar to the third location than it is to the workplace in terms of disadvantage, especially for Whites.

Our exploratory analyses also involved fitting multi-level statistical models to explore the consequences of social isolation as measured by the characteristics of an individual's *activity space*, or set of locations where the person spends time. To date, we have focused on the relationship between child victimization and disadvantage. We compared the effect of disadvantage on various types of victimization for a measure of disadvantage based solely on the census tract of residence to the effect of a disadvantage measure based on the average disadvantage level in the residential, workplace, and third location for the randomly sampled adult in L.A. FANS corresponding to each child. Initial results suggest that theft victimization is greater at the lower and upper levels of the disadvantage distribution for both the residual-only and activity space-based measures. We plan to build on these types of analyses in the future using the more sophisticated measures of an individual's activity space discussed below.

Activity space measures. Using the full extent of the geographic information provided by L.A. FANS about the locations in which people spend time, we have been working on creating geospatial-based activity spaces for adult survey respondents. As mentioned above, as our preliminary activity spaces were initially defined based solely on residence, workplace, and third location. We are now in the process of calculating more detailed activity spaces using other location information including the most visited grocery store, the place where one goes for emergency food, church location, residence of children/stepchildren, residence of parent\stepparent, and the place visited when sick. Consistent with conventional geographic approaches to defining activity spaces, we have constructed one and two standard deviational ellipses using all available location data for each individual. Future steps will involve creating more advanced and innovative activity space measures based on kernel density estimation. Once these are in place, we will develop a paper that describes our measures and procedures, and evaluates the utility, strengths, and limitations of our measures relative to current strategies for developing activity space measures in spatial crime behavior. The paper will also assess the relationship between activity space and other behavioral outcomes.

Los Angeles County School Data. Because we are interested in how, where, and in what context time spent outside of one's neighborhood affects behavior, and because children spend a great deal of time in school, we decided to calculate measures of school context for analyses involving children's outcomes. Thus, we are currently gathering school-level data for all schools in Los Angeles County. These data include information about the demographic characteristics of students, as well as information on: enrollments, truancy, suspensions, and expulsions; and graduation and dropout rates. These data will be linked to the school location information in L.A. FANS, allowing us to assess how children's school environments affect problem behaviors.

Progress towards Achieving Broader Impacts

We have also begun to make progress toward achieving some of the proposed broader impacts. One of the broader impacts involves continuous work toward the substantive goals of the project. That is, the collective enterprise of this project will join conceptual ideas and research findings from sociology and geography with innovative measurement and methods from geography, transportation science, and statistics. Our work thus far consists of first steps toward this end. We also proposed to hold a conference during the second year of the project that would bring together participants from multiple disciplines conducting research on the measurement, patterns, and/or consequences of space-time use for human problem behaviors. This conference will allow

for exchange of ideas regarding methods and substantive findings about the spatially and temporally embedded dynamics of human behavior across a wide array of scholarly communities. We have begun to plan this conference and have secured the participation of three of four keynote speakers. We have identified additional participants but have not yet confirmed their availability. The project also proposed to broaden participation and perspectives by enhancing the training and careers of graduate and undergraduate students from diverse backgrounds. The most immediate way in which we are accomplishing this goal is through involving graduate research associates from the multiple disciplines in all stages of the project so that they are all trained in the use of the substantive, measurement, and statistical tools of the project regardless of their own fields of study. Second, we were careful to bring onto the project an integrated group of students. There are four graduate students on the project–one each from geography and statistics, and two from sociology. Two of the four students are persons of color–one African American and one Latino. During the upcoming academic year we will bring in undergraduate associates to work on components of the project and to advance their research skills and training.

Project Title: Dynamics of idea generation in individual and group brainstorming: A multidisciplinary approach using network models and behavioral experiments

Proposal Number: 0729470, 0729305, 0728413

HSD Emphasis Area: Dynamics of Human Behavior and Decision Making, Risk, and Uncertainty

Lead PI: Simona Doboli, Hofstra University
PI: Ali Minai, University of Cincinnati
PI: Paul Paulus, University of Texas at Arlington
Co-PI: Daniel Levine, University of Texas at Arlington

Project Goals:

- To understand how cognitive and social processes interact to enhance or inhibit creative idea generation in group brainstorming.
    a. Study the internal dynamics of individual idea generation and that of searching and forming novel conceptual combinations through neural modeling.
    b. Study the effects of external hints and ideas from other group members on idea generation during group brainstorming.
    c. Validate experimental results with the neural model and use the neural model to generate predictions and recommendations.

Thematic Areas:

- Group and individual idea generation

Methodologies:

- Neural models of idea generation in individuals
- Neural models of idea generation in group brainstorming
- Behavioral experiments in group brainstorming

Recent Findings

The long-term goal of our collaborative project is to understand how cognitive and social processes interact to enhance or inhibit creative idea generation in groups (often referred to as "brainstorming"). As science, engineering, business, geopolitics and socioeconomic systems become more complex and more distributed, reliance on work teams and networks of teams is becoming increasingly necessary and understanding the impact of groups and teams on innovation and creativity is an important goal.

Although group ideation has been a topic of study by social and organizational psychologists for some time now, the field still lacks the perspective of psychologically and neurally plausible model of individual idea generation which is at the same time detailed enough to provide real insights at the level of the individual and simple enough to serve as the basis for modeling potentially complex group interactions.

Neural Modeling Results

Individual Idea Generation Model

Investigators Doboli, Levine, and Minai have been developing models of individual idea generation and search for novel combinations, and Minai has been making progress on modeling group dynamics. As we work towards finding the best representation of the dynamics of the idea generation process, we have explored a number of related but different models of individual idea generation. The various approaches have the following elements in common:

- Hierarchical representation of knowledge with features, concepts, categories (fixed and dynamic categories) and ideas.
- Inhibitory modulation that allows the system to shift, broaden, narrow and otherwise modify the scope of search in the space of ideas.
- A critic module that analyzes the current response and feedbacks a reward type of signal that is used in controlling the modulation of inhibition.
- Ability to form and consolidate new categories and ideas.

(UC) The model developed by Minai has been implemented as a connectionist system and refined over several iterations (Doboli et al., 2007 Iyer et al, 2007, 2008a, 2008b). It was applied initially to non-semantic toy problems to explore its basic dynamics (Iyer et al., 2008a). The architecture of the current system is shown in Figure 1. Over the last three months, the model has been extended to handle simple brainstorming domains such as planning a vacation or a meal. While the data used to configure the system in these cases is still rather artificial, it has allowed us to explore the logic of the system's dynamics, to identify potential difficulties, and to address several of these through modifications in the original model.

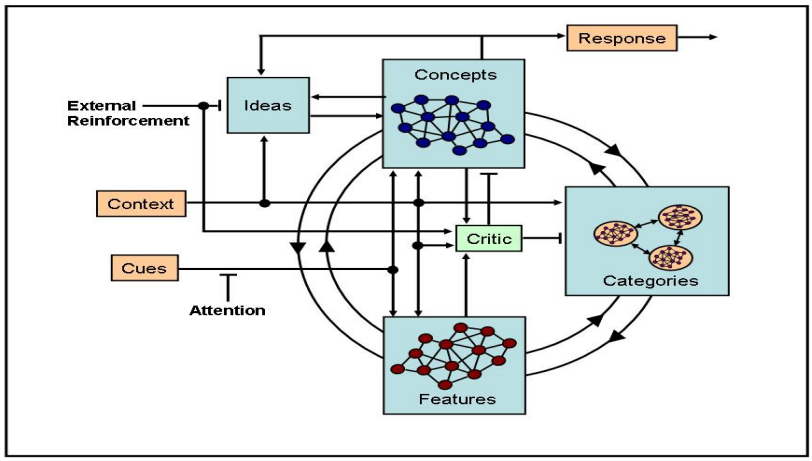

Figure 1: Architecture of the computational model for idea generation

Currently, the system is able to do the following:

- Generate sensible ideas in each of several "familiar" contexts, i.e., contexts whose domain information is already coded in the system's weights.
- Generate context-appropriate sensible ideas in unfamiliar contexts similar to familiar ones, and to improve these based on feedback from the critic.
- Discover context-appropriate ideas in initially unfamiliar contexts based on feedback from the critic.
- Search autonomously for novel combinations of categories.

Each idea generated by the system shown in Figure 1 is evaluated by three criteria: (a) *Admissibility (A)*: Does the idea satisfy the necessary requirements for the problem?, (b) *Quality (Q)*: Does it have especially appropriate/desirable attributes? and (c) *Novelty (N)*: Is it unfamiliar/unexpected based on previous experience? The system was simulated in four modes: 1) Convergent, where the search tends to stay in the biased category or closely related ones, 2) Divergent, where the search can merge with or jump to other categories, 3) Free association with no noise, and 4) Free association with irrelevant cues as noise. The novelty measure is higher in the last three cases, though in the last case, the system is easily disturbed and its ideas can have a low admissibility. Some results from the model are: *Convergent:* cruise, five star hotel, island, chalet (A=1, Q=0.85, N=0.45); *Divergent:* hiking, Disney world, nature trail, rock climbing (A=1,

Q=0.16, N=0.66); *Free-Association (No Noise):* hostel, amusement park, park, IMAX movie (A=1, Q=0.18, N=0.6) ; *Free-Association (With Noise):* regular bus, train, IMAX movie, driving around (A=1, Q=0.2, N=0.7).

(UTA) Levine has made progress on a variation of the model designed to simulate data from Paulus laboratory regarding which types of idea or category priming are most effective in stimulating idea generation in a group setting. This simplified model is a continuous nonlinear dynamical system whose variables represent activations of categories and of ideas within those categories. There is feedback between idea nodes and category nodes, and the category nodes are also influenced by priming signals. Thus far, there has been partial success in modeling the data of Coskun et al. (2000), showing that sequential presentation of a large number of categories is more effective than simultaneous presentation of those categories. The simulations also partly reproduce the Coskun et al. data showing that priming a large number of categories generates more ideas than priming a small number of categories, which in turn generates more ideas than the condition with no priming.

(Hofstra) Doboli has investigated the search dynamics on a simplified model of category/concept space using continuous dynamics. The goal was to find internal (i.e. connectivity structure) and external (i.e. priming) conditions that lead to a more efficient and effective search for good combinations of concepts. Currently, simulations on a small version of the model show that the system is able: (a) to explore the structure of the concept space to find novel associations between categories, and (b) to inhibit strong 'bad' associations.

Group Idea Generation Model

(UC) While most of the effort in Year 1 has focused on the individual model, Minai's lab has initiated work on developing a preliminary agent-based model for group brainstorming. The group is modeled as a social network where each interacting agent is represented as shown in Figure 2. The idea generation module for the agent corresponds to the individual model described above, though a much more simplified connectionist network is used in the current model. The focus is primarily on the following issues:

- Understanding how interactions among agents can facilitate or obstruct the individual ideation processes of the group.
- Modeling the effectiveness of convergent and divergent styles of ideation, and the pros and cons of heterogeneous vs. homogeneous groups.
- Exploring the effect of structural connectivity and interaction protocols among agents on the performance of the group as a whole.

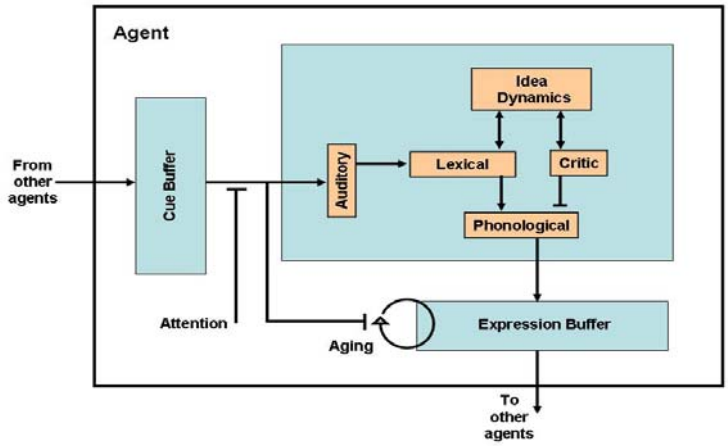

Figure 2: Agent architecture.

Our approach builds on the associative memory model of Brown and Paulus (1998), using an associative recurrent neural network to represent the dynamics of search in semantic space. The activity states of the network represent ideas, and the network's state space corresponds to the space of ideas. Each agent's network is configured to divide this space into different domains – each representing a different search space. Convergent thinking is modeled by high barriers between domains, so the search tends to remain confined to a single domain, while divergent thinking is modeled with low barriers and easy switching between domains. In the current version of the model, the goal is for agents to discover good ideas (i.e., activity states) hidden among a much larger number of bad ones.

Behavioral Experiments

Study 1 (UTA). In one completed study from Paulus laboratory, we examined the effects of different intervening tasks during a 5 minute break from brainstorming. Past studies demonstrated that such breaks increase the number of ideas generated in a second session. We manipulated different activities during the breaks to assess various theoretical predictions about factors that should facilitate or inhibit the utility of the break period. It was found that presenting stimuli during the break enhanced subsequent idea generation. A demanding cognitive activity during the break (memorizing an unrelated passage) hindered subsequent idea generation. According to the associative memory perspective, while brainstorming it is important to retrieve relevant concepts from the long term memory and combine them with information in working memory. Exposing participants to ideas during the breaks causes them to register information in the working memory which in turn activates certain concepts (ideas) in the long term memory. This activation sparks more ideas and helps brainstormers access new categories of ideas. However, asking participants to memorize a passage during the break for a comprehensive test caused them to generate the least number of ideas and use the least number of categories than all other conditions. It is possible that in this condition the task-relevant information in working memory was displaced by the contents of the task-irrelevant passage. The forgetting fixation hypothesis states that taking breaks is helpful in removing fixation and allows problem resolution (Smith & Blankenship, 1991). However, the results indicate that during short breaks, working on task-relevant activities enhances performance more than taking time away from the problem.

Study 2 (Hofstra). Past research has shown that exposure to the ideas of other group members and/or externally provided primes or hints can have positive effects on individual performance. Unfortunately, when these other ideas are at odds with an individual's current train of thought because of conceptual mismatches or inopportune timing (or more likely both) – individual performance can be negatively impacted. In order to take advantage of the facilitating effects of the exposure to other ideas, while minimizing the interfering effects, we are conducting a series of experiments using a novel paradigm where individuals can request hints at times of their own choosing throughout a brainstorming session. Our results so far indicate that individuals requesting hints outperform a control group that is not provided with hints and individuals who choose not to request hints. This paradigm allows us to analyze individual responses to specific hints. We are finding some consistent patterns of responses. Individuals will often respond to general hints ("We need better parking") by providing a specific instance ("A parking structure should be built close to the center of campus"). Hints that are more specific ("We need more variety of food in the cafeteria") will tend to evoke a modification ("More ethnic cuisine would make the food court less boring") or a related idea ("More different types of coffee and tea should be available").

Study 3 (Hofstra). The generation of novel conceptual combinations is an important source of creativity that has been neglected in group brainstorming research. We have some preliminary results suggesting that individuals may be better than groups at integrating a diverse set of categories into a coherent conceptual theme, but once combined, groups may be superior at

coming up with more diverse and more creative (although not necessarily a greater number of) instances of the new category.

Study 4 (UTA). Another study examined the issue of task distribution during brainstorming. This study investigated whether the assigning categories that are high or low in relatedness will lead to higher quantity, flexibility, originality, clustering of the ideas. Participants in electronic brainstorming groups of three were either jointly assigned to focus on three categories of a broader problem or they were individually assigned to focus on one of the three categories. The groups jointly assigned generated a higher quantity of ideas, explored more categories and exhibited higher clustering than the groups who were assigned with individual categories. Groups assigned with categories of low relatedness surveyed more categories than those assigned with categories of high relatedness. The results of this study have implications for models of the group creative process (Nijstad & Stroebe, 2006; Paulus & Brown, 2007) and the computational efforts of the team members.

Challenges, Opportunities, and Future directions:

Modeling

The challenges for the individual model are:

- Analyzing the dynamics of the category layer as a flexible neural system for working memory and cognitive control.
- Automating the configuration process so that the system can learn autonomously from databases of domain knowledge.
- Moving from localized, discrete-time representations in each system to distributed, continuous-time ones.
- Studying the system's response to context manipulation to calibrate it against experimental data.

We plan to integrate the results of the three modeling efforts from UC, Hofstra and UTA and to validate the model on the new experimental results on the hints study (Study 2), As work on the group model advances we will be able to model the experimental results on groups (Study 1, 3 and 4). The integrated connectionist models will be informed by known results on the roles of several brain regions in idea generation and selection, including concept storage and retrieval in the temporal cortex, working memory manipulation in the prefrontal cortex, and action selection in the basal ganglia.

Behavioral Experiments

Our team is planning a series of new studies this year that will focus on at least three areas. One is a greater understanding of the effect of breaks in the brainstorming process, following up our prior research and the dissertation research of Kohn. We will examine the effects of lengths of breaks, since longer breaks should provide more opportunity for the retrieval and combination processes that should provide the basis for enhanced ideation after the break. However, presenting participants with examples of ideas with a high level of typicality prior to the break may increase the potential for fixation and limit the retrieval and combination process during the break.

We will also investigate the effect of diversity in group composition (ethnic diversity) on the processing of shared ideas. There are conflicting theories about the impact of such diversity on the creative process. In particular we are interested in the extent to which group diversity affects the degree of attention paid to shared ideas and the deeper processing of such ideas. Because there is a general belief that diversity is beneficial to group task performance, participants in such groups may be motivated to attend more carefully to the ideas of those with different background or expertise. As a result, the ideas shared by dissimilar others should be more influential increasing the number and quality of ideas generated by group members. In contrast, some

perspectives suggest that our general distrust and reservations about those who are different will limit our attention to and processing of ideas shared by dissimilar others. Which of these patterns occurs may be influenced by personal characteristics (degree of positive attitude to diversity) and whether groups have a cooperative or competitive orientation. . Finally, we have begun research on the process of combining ideas that have been generated in a prior session. All research on brainstorming has focused on the generation aspect but has ignored the process of combining ideas to create even more unique ideas. We will vary whether the prior brainstorming and the subsequent combination process is done collaboratively or on an individual basis using the electronic brainstorming paradigm. One key question will be whether individuals (nominal groups) or interactive groups will be better at the combination process. The individual paradigm might allow for a more careful evaluation of all of the ideas that were shared in the prior session and one's relevant semantic network in order to generate additional ideas that involve in some fashion the shared ideas. Group interaction may limit the personal cognitive search and processing time. Alternatively, group interaction may motivate participants to work harder on this difficult task and examples of combinations generated in the group may stimulate group members to come up with additional combinations (cognitive stimulation during the combination phase).

Project Title: Warning Decisions in Extreme Weather Events: An Integrated Multi-Method Approach

Proposal Number: 0729511

HSD Emphasis Area: Decision Making, Risk, and Uncertainty

Lead PI: Jeffrey Lazo, National Center for Atmospheric Research
Co-PIs: Ann Bostrom (University of Washington), Kathleen Tierney (University of Colorado Natural Hazards Center), Rebecca Morss (National Center for Atmospheric Research), Jeannette Sutton (University of Colorado Natural Hazards Center)

Project Goals:

The project focuses on investigating warning-related decisions in two types of extreme weather hazards in different geographic areas — flash floods in Boulder, Colorado, and hurricanes in Miami, Florida. We are investigating the following research questions:

- Q1a: How do forecasters communicate forecast and warning information for hurricanes and flash floods?
- Q1b: How do public officials, mass media organizations, and members of the public obtain forecast and warning information for hurricanes and flash floods?
- Q2: How is this forecast and warning information (including uncertainty) interpreted and used by these different groups?
- Q3: What are the preferences and values of members of the public for different attributes of forecast and warning information, and how do these preferences and values differ across subgroups?
- Q4: What factors—including forecast/warning attributes, uncertainty, and other contextual factors—influence decision making and action?
- Q5: What are the implications of this research for the design and management of integrated warning systems for extreme weather events?

Thematic Areas:

- Communication and decision processes related to warnings of extreme weather events, including uncertainty information
- Perceptions, interpretations, use, and value of warnings of extreme weather events
- Mental models underlying communication, interpretation, and decision processes related to extreme weather warnings
- Similarities and differences among forecasters, public officials, media, and members of the public in the areas covered in the three bullets above

Methodologies:

- face-to-face organizational interviews with forecasters, public officials, and media personnel
- focus groups with public officials, media, and study area residents
- face-to-face mental model interviews and decision modeling with National Weather Service forecasters, through individual and group elicitation
- face-to-face mental model interviews with public officials, media, and study area residents
- bilingual (English/Spanish) stated preference survey of Miami area residents
- interdisciplinary weather warning workshop with forecasters, public officials, and media personnel

Recent Research Findings:

The research project commenced in summer 2008, and the first few months have focused primarily on organizational and planning issues in order to develop a coordinated project. The team has been meeting in person and via conference call to decide timing of research

components, develop and share protocols for research to be conducted over the next few months, discuss how to integrate data collection and analysis, and discuss a possible team workshop to cross-train personnel in different methods.

Challenges and Opportunities:
Challenges: timing research components so as to reduce potential order effects and not over-tax subjects, coordinating data collection (including research protocols) across different methods, cross-disciplinary training and interaction among investigators, analyzing findings across methods.
Opportunities: Potential for unique multi-method, cross-disciplinary study that develops a holistic understanding of how extreme weather warnings are communicated, obtained, interpreted, and used in decision making by different participants in the warning and decision process, and that enhances effective warning communication and sound decision making in extreme weather events.

Project Title: Dyadic Rapport within and across Cultures: Multimodal Assessment in Human-Human and Human-Computer Interaction

Proposal Number: 0729515

HSD Emphasis Area: Dynamics of Human Behavior

Lead PI: Prof. Gina-Anne Levow, University of Chicago
Lead PI: Prof. Jonathan Gratch, University of Southern California
Co-PIs: Susan Duncan, PhD, University of Chicago
International Partners: Prof. Rima Aboudan, United Arab Emirates University, Al Ain, UAE

Project Goals:

- Phase 1 - Complete a cross-language/cultural comparison of dyadic story-telling interactions in three populations: American English and Mexican Spanish speakers (to be collected in Chicago), and Gulf/Iraqi Arabic speakers (to be collected in the United Arab Emirates). Analyses will discern verbal/vocal and nonverbal behaviors that are culture-specific and that enable members of a given culture to maintain a sense of rapport with one another.
- Phase 2 - Based on results of Phase 1 analyses of human dyads, program behavioral repertoires for 'Embodied Conversational Agents' (ECAs). ECAs are human-looking, computer-generated figures capable of a range of interactive behaviors. To be carried out at the University of Southern California, Institute for Creative Technologies, this work will focus on behaviors typical of *listeners* in our three language/cultural groups. These will include, for example, paterns of posture, gaze, nodding, facial expression, and vocal feedback or 'back-channel' utterances. ECAs capable of real-time capture and analysis of certain dimensions video and audio data from a human partner in interaction will model the culturally distinctive behaviors of listeners in our three target cultures.
- Phase 3 - Videotape human participants in interaction with the ECAs, manipulating behaviors identified in Phase 1 as related to the maintenance of rapport in the three target cultures and observing effects on our human participants. If nonverbal cues necessary for rapport among members of the human participant's culture are infrequent or absent in an ECA that models a member of a different culture, what effect may this have on the human participant's pattern of interaction with the ECA and his/her evaluation of the 'quality of interaction' achieved with the ECA?

Thematic Areas:

- Cross-cultural communication - Identification of aspects of behavior that scaffold successful intercultural interaction.
- Training - Further development of perceptive animated agents with potential roles in computer-aided language learning applications and in training procedures for U.S. service personnel in foreign cultural contexts.
- Basic science - Development of programmed interfaces (ECAs) for use in controlled scientific elicitations of human responses to subtle behavioral signals in interaction partners, which may be difficult to instantiate in human trained research confederates.

Methodologies:

- We are currently halfway through Year 1/Phase 1 of our three-phase project, so are collecting our human interaction data from members of the three target language/cultural groups. Dyads with pre-existing rapport (e.g., friends, family members) participate in a story-telling interaction. We videotape with three camcorders as the participant who has seen a short eliciting film (Speaker) tells the story of it to the participant who has not seen it (Listener). Listeners are actively engaged, knowing that they must later re-tell the story to an investigator. Closeup camcorder views on Speaker and Listener enable analysis of facial expression (<http://www.face-and-emotion.com/dataface/facs/description.jsp>). A

third view capturing both members of the dyad enables analyses of gesticulation and posture. Audio is collected from head-worn microphones to enable acoustic analyses of vocal behavior. The elicitation data are digitized from videotape into audio and video files suitable for analysis using several software tools. For all the elicitation data, speech is transcribed by native speakers of the language of elicitation. For the English and Spanish speech data, initial transcription is accomplished with Praat (<http://www.fon.hum.uva.nl/praat/>). For the Arabic language data, initial transcription is created as fully vowellized Arabic orthography in text documents. These texts are then transcoded into a left-to-right Roman-character transliterated version using a program being refined as part of this project at MITRE, Corp. The transliterated texts are then imported to Praat.

Our later analyses of multimodal language and interaction behaviors depend on fine-grained time alignment of the words in the speech signal to the accompanying video. To reduce the burden on transcriber-analysts, we have developed a semi-automatic process to align our English, Spanish, and Arabic texts to the digitized audio signal. This process uses a version of the Sonic speech recognizer developed at the University of Colorado (Pellom et al., 2000. <http://cslr.colorado.edu/beginweb/speech_recognition/sonic.html>) to perform word and phoneme alignment consistent with the coarse-grained transcription. Since Sonic has only an English pronunciation lexicon, letter-to-sound rules, and phone model set, we perform language porting to support alignment in Spanish and Arabic. We create a mapping from a phone set suitable for each language to the ARPABET representation employed by Sonic, as well as a pronunciation lexicon covering the transcribed vocabulary using this new phone set. For the Arabic, additional steps currently under development at the University of Chicago, are required to convert from the Roman-character transliteration format to Sonic-based alignment. The above processing sequence, for all three languages, can reduce the time to achieve word-level alignment in the transcript for an elicitation, from several days to a few hours.

For annotating our multimodal (speech and nonverbal) language and interaction behavioral data we use the annotation and language archiving software package, ELAN (<http://www.lat-mpi.eu/tools/elan/>), developed by the Max-Planck Institute for Psycholinguistic Research in Nijmegen, The Netherlands. This tier-structured annotation interface permits the human observer/analyst of nonverbal behaviors to isolate dimensions of behavior, such as posture, gaze, and gesticulation on tiers that allow tagging and labeling of behavioral events in relation to a single time line that unifies all annotated behavioral streams (at the level of the individual and that of the dyad) and permits assessment of their co-occurrence and sequential patterning through time.

The resulting combination of digitized audio-video data, time-aligned transcripts, and annotations reflecting human analysts' close observations of nonverbal behavior is then amenable to a variety of analyses of lexical and prosodic cues in connection with gesticulation and variations in posture, gaze, and other behaviors. To support automatic analysis and synthesis of behaviors associated with rapport in dyadic interactions, we will draw on analyses of regularities observed in the human-annotated behavior streams with the aim of developing and training automatic classifiers that can both identify the level of rapport and predict the timing and type of multi-modal signals of rapport.

Recent Research Findings:

A corpus of 24 English-speaking dyads, 13 Spanish-speaking dyads, and 2 Iraqi Arabic-speaking dyads is so far assembled. While full multi-modal annotation on several dozen ELAN tiers representing distinct behavioral streams is underway, we have begun with analyses of the speech data by focusing on lexical and prosodic cues which are supported by the semi-automatic transcriptions and alignment described above. We currently focus on developing a set of classifiers in an analysis-by-classification approach to explore which prosodic or lexical features best predict backchannels in dyadic communication. We employ a rich set of prosodic features

including z-score channel-normalized pitch and intensity maximum, mean, and range across a speech span, duration, speaking rate, and stylized pitch contour. All measures are extracted using Praat for signal processing driven by Python scripts, except for speaking rate, computed using mrate (Morgan et al., 1997). Classification is performed with the Weka machine learning toolkit. Preliminary experiments found reduced intensity to be the best predictor of backchannel response in some English-speaking dyads.

Challenges and Opportunities:
To support the larger-scale signal processing required for audio and video analysis of our rapidly growing dataset as well as to support distributed research access to these materials, we have begun integration of these materials in the Social Informatics Data Grid ('SIDGrid') repository at the University of Chicago. (<https://sidgrid.ci.uchicago.edu/index.php?q=home>). We have uploaded exemplar dyadic interactions annotated in ELAN into a group-access restricted area of the SIDGrid repository. The SIDGrid architecture currently supports distributed parallel execution of several Praat-based prosodic extraction routines on multiple such interactions by dispatching these jobs to the TeraGrid, the largest distributed open science infrastructure. We plan to incorporate our new prosodic feature extraction routines into this framework to facilitate experimentation, as well as to support new multimedia analysis tools as they are created.

Project Title: The dynamics of religion and conflict: A multidisciplinary, empirical approach

Proposal Number: 0729516

HSD Emphasis Area: Agents of Change

Lead PI: Steven L. Neuberg, Arizona State University
Co-PIs: Carolyn Warner, George Thomas, Roger Millsap, David Schaefer, Benjamin Broome, Juliane Schober, Michael Winkelman, Thomas Taylor (all Arizona State University)

Project Goals:

- To articulate a theoretically-informed model that integrates across multiple levels of analysis to predict religion-influenced conflict;
- to gather cross-national data to test this model, in the process creating a powerful, but relatively inexpensive, method for gathering cross-cultural data;
- to generate new data-based insights into the role that religion plays in intergroup relations; and
- to enhance understanding of a set of processes that have direct implications for the lives of individuals and groups across the globe, for the management of international affairs, and for the maintenance of national security; and
- to enhance scientific infrastructure by establishing an international pool of social scientists to potentially serve as expert informants to facilitate research on a wide range of other important social questions.

Thematic Areas:

- Intergroup Conflict
- Religion
- Cross-cultural, cross-national research

Methodologies:

- Employing an innovative Internet-based survey methodology, a large, international network of social and behavioral scientists (app. 1000) will be recruited to provide data about 100 locales around the world. This method provides the ability to explore many locales, gather quantitative data about many relevant factors, reduce the potential impact of biases in expert informant's reports, and conduct modern statistical analyses, thereby enabling the investigators to discover whether there are fundamental, cross-cultural principles through which religion may enhance or decrease conflict.
- A wide range of hypotheses will be tested employing both conventional statistical techniques (e.g., path analyses) as well as Bayesian network analyses.
- Contemporary agent-based modeling techniques will explore the implications of our findings and generate novel hypotheses for subsequent testing.

Recent Research Findings:
This project commenced on January 1, 2008. In line with our proposed timeline, we have been developing the survey instrument, beta-testing it, creating web-based versions of it, and developing mechanisms for recruiting expert informants. We are on schedule, and hope to deliver the surveys and receive responses by the end of December 2008. Thus, as expected, we have no findings yet, but are on track.

Challenges and Opportunities:
There exists little in the way of comprehensive, theoretically coherent, data-based knowledge about the manner in which religion influences conflict processes. Such knowledge is critical for analyzing conflict situations, for being able to anticipate the emergence of conflict situations, for informing policies and anticipating policy influences, and for creating interventions to defuse potential conflicts or better manage existing conflicts.

Although many disciplines in the social and behavioral sciences, as well as the humanities, have theorized about religious influences on conflict processes, these disciplines often apply vastly different perspectives on the issue; each discipline thus blinds itself from constructs that may be critically important. In contrast, our approach is explicitly multidisciplinary: We build upon insights and findings from a wide range of disciplines (e.g., social psychology, political science, religious studies, anthropology, sociology) to generate a conceptually coherent set of hypotheses about where, how, under what circumstances, and for whom religion-influenced conflict could emerge. The challenge posed by multidisciplinarity itself provides a significant opportunity.

A second challenge is methodological. The thick descriptions generated by well-done case studies are extremely useful for generating theory, but limited in their ability to test it comprehensively. Quantitatively-focused studies have been severely hampered by existing data sets that have employed simple (and often only extreme) indicators of conflict and measures of religion that fail to appreciate its complexity. Needed is a systematic, cross-setting study to assess empirically the generality of theoretical insights. Our methodological approach adapts validated procedures from political science and psychological research. Specifically, it leverages the expertise of a broad network of scholars who possess, collectively, great knowledge about the social, political, religious, and psychological circumstances of hundreds of locales around the world. This informant methodology will allow us to acquire information about theoretical constructs of interest from many international locations, thereby making possible foundational inferences about religion-conflict processes—inferences that should extend beyond those generated by existing data sets and even the most valuable studies employing case-study methods.

A third class of challenges is practical—for instance, the successful creation of surveys that will be conceptually comparable across 100 international target sites, and the recruitment of 1000 expert informants, each of whom is to provide via the internet surveys data on one of these sites. We are pleased with our approach to these challenges thus far, and are optimistic that we will be successful. If so, we will have created an important, novel data set uniquely useful for exploring scores of significant hypotheses.

Religion-influenced conflict has direct implications for the lives of individuals and groups across the globe, for the management of international affairs, and for the maintenance of national security. This project thus aims to generate a data-based understanding of the role that religion plays in intergroup relations, while also creating an innovative and relatively inexpensive method for performing cross-cultural research.

Project Title: Collaborative Research: Cultural and Genetic Basis of Social Support Use

Proposal Number: 0729532

HSD Emphasis Area: Dynamics of Human Behavior

Lead PI: Heejung S. Kim, University of California, Santa Barbara
Co-PIs: David K. Sherman, UCSB, Shelley Taylor, UCLA, Jun Xu, Tufts University
International partner: Eunkook Suh, Yonsei University (Korea)

Project Goals:
Utilizing the theoretical frameworks of cultural psychology, health psychology, and behavioral genetics, this project formulates a specific theoretical model on the sociocultural and genetic basis of stress coping. The present model focuses on how sociocultural factors (e.g., engagement in religion or national culture) influence the behavioral outcome of particular genes. It is hypothesized that genes will influence psychological predispositions (e.g., stress reactivity), and sociocultural factors would moderate the social behaviors stemming from such predispositions (e.g., trying to exert personal control or using social support).
The study that we describe in the present report examines the role of religion, as organized systems of values and practices that teach its members the assumed ideal and normative set of behaviors, thoughts and feelings. In particular, research has shown that people from different religious backgrounds cope differently in stressful situations. For example, Christianity is associated with the motivation to actively control the environment (Weisz, Rothbaum, & Blackburn, 1984). Building on these findings, we investigated how religious affiliation and genes together impact stress coping.

The polymorphism we examined in this investigation is $5HT_{1A}$, which is associated with stress reactivity (Graeff et al., 1996). 5-HT1A is a serotonin receptor gene (C/C, C/G, G/G genotypes) that has been linked to neuroticism and panic attacks. In particular, G allele for serotonin receptor gene is associated with depression and anxiety (e.g., Huang et al., 2004). Thus, we hypothesized that people with G/G allele would be more reactant to a stressor, and therefore have a greater need for stress coping, compared to people with other alleles. However, we also hypothesized that what people choose to do in coping with the stress would be impacted by their religion. In sum, we hypothesized that Christians would try to exert greater control over their situation (e.g., using more active coping and trying to change situations), compared to non-religious people, and this difference would be particularly pronounced among people with the G/G genotype of $5\text{-}HT_{1A}$ than among people with C/C or C/G.

Thematic Areas:
Cultural psychology, religion, health psychology, psychopathology, behavioral genetics, stress and coping

Methodologies:
This study was a part of a larger study for which we have collected data from 325 participants from Korea and the U.S. The samples were drawn from both college students and community members. We are currently conducting DNA analyses and the study described in the present report is based on a subset of samples with completed genotyping. In this specific study, the samples are consisted of 38 Christians (20 with G/G allele and 18 with C/C or C/G allele) and 66 non-religious participants (25 with G/G allele and 41 with C/C or C/G allele)[1].

[1] The sample included a small number of non-Christian religious people (e.g., Buddhists, Jews, Muslims), but the number is not sufficient to include as a separate group at this time, and thus, they were excluded in the report. However, a cursory analysis shows that their responses on these questions on control were very similar to non-religious participants.

In the present study, we measured the active coping strategies (i.e., trying to actively influence and control the circumstances) and religious affiliation using a self-report survey method. For DNA samples, saliva samples were collected with Oragene DNA collection kits (DNAgenotek, Ottawa, Canada) and DNA was extracted using the Puregene kit (Qiagen, Valencia, CA). The yield, measured on a spectrophotometer, varied greatly between DNA samples ranging from 10 microgram to 300 microgram. The low yield samples were concentrated in a SpeedVac. The HTR1a C(-1019)G polymorphism (SNP ID: rs6295) was assessed on a ABI 7500 real time PCR machine (ABI, Foster City, CA) using the allelic discrimination method.

Recent Research Findings:
Effect of Genetics and Religion on Active Coping

Controlling for the stressfulness of the event and the level of felt responsibility, there was a marginal main effect of genotype, $F(1, 97) = 2.88$, $p = .09$. Individuals with the G/G genotype used marginally more active control coping than people with the C/C or C/G. Christians used somewhat more active control coping than non-religious people, although this difference was not significant, $F(1, 97) = 2.55$, $p = .11$. However, as expected, there was significant gene X religion interaction, $F(1,97) = 4.17$, $p = .04$. Among those with G/G, Christians used more active coping than non-religious people, $p = .01$. Among Christians, G/G people used more active coping than C/C or C/G people, $p = .02$.

In sum, in a first demonstration of the utility of our theoretical model, we found that a sociocultural factor (religion) moderates the effect of a particular genotype associated with stress reactivity ($5HT_{1A}$) on culturally specific coping-strategies (active control coping). We are currently analyzing data from the full sample to apply this model to understand other ways that sociocultural and genetic factors can influence and interact in individuals' coping and social support use (Kim, Sherman, & Taylor, 2008).

Challenges and Opportunities:
Challenges in this project have included international data collection, coordination among researchers at four universities, extending data collection to include community samples, and integrating psychological and genetic approaches to the research process. However, these challenges present great opportunities for a greater understanding of human and social dynamics.

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Acknowledgements
We thank Joni Sasaki, Marie Iconomopulos and Cecilia Ma for their work on this project.

Project Title: Transferring to Regulatory Economics the Risk-Analysis Approaches to Uncertainty, Interindividual Variability, and Other Phenomena

Proposal Number: 0756539

HSD Emphasis Area: Decision Making, Risk, and Uncertainty

Lead PI: Adam M. Finkel, University of Pennsylvania Law School
Co-PIs: Sandra Hoffman, Resources for the Future, Scott Ferson, Applied Biomathematics and Eldar Shafir, Princeton University (Psychology Dept.)

Project Goals:

- Analyze the typical and cutting-edge treatment by regulatory economics of several phenomena that are now routinely explored by risk science, notably uncertainty and interindividual variability;
- Explore reasons why cost-benefit decision-making may suffer from incommensurate treatment of uncertainty and variability in risk *versus* in cost;
- Construct two detailed case studies to show how economists could analyze interindividual variability in the cost of environmental regulations;
- Develop a theory of "cost perception" to explain how laypeople and experts perceive the costs of regulatory programs, and how these perceptions are affected by information about uncertainty and variability.

Thematic Areas:

- environmental risk assessment
- cost-benefit decision-making
- regulatory economics
- public perception

Methodologies:

- comprehensive review of recent regulatory cost analyses produced by federal health, safety, and environmental agencies, along with review of scholarly literature on the pros and cons of Monte Carlo simulation (for analysis of uncertainty) and general equilibrium analysis (for investigation of distribution of costs) in regulatory cost accounting;
- structured interviews with Agency and academic economists, exploring reasons for the production of cost analyses that do not fully consider uncertainty and interindividual variability;
- psychometric survey research with expert and lay subjects, to explore perceptions of regulatory costs (both hypothetical and real programs, with and without information on uncertainty and variability);
- *de novo* computable general equilibrium modeling of case examples of regulatory interventions, to explore variability.

Recent Research Findings:
Six months into this project, the project team has now organized itself into task groups, brought two Penn Law students into the project, and prepared detailed sentence outlines (approx. 15 pages of new material subsequent to the proposal) of three journal articles we expect to produce during the next 9 months. These articles will set forth (separately) the major economic, psychologic, and philosophy-of-science issues that we will explore in greater detail during the remainder of the project term, will foreshadow specific empirical research and case study development, and will present preliminary findings exploring the current state-of-practice in how

regulatory economists treat uncertainty and interindividual variability. The three papers will consist of:

- A wide-ranging discussion, both mathematical/statistical and theoretical/ethical, of why consideration of uncertainty and variability is equally important on both the 'cost' side and the 'risk' side of the ledger. This article will include some careful attention to the definitions of uncertainty, variability, cost, and risk that we will use throughout the remainder of the project. We will then proceed to critique both the applicable guidance documents in force at the major federal environmental/health/safety regulatory agencies (and the guidance developed by OMB) and a preliminary sample of recent major regulations promulgated by these agencies, to produce a snapshot of how uncertainty and variability in regulatory cost are currently handled. We will propose both 'bottom-up' (Monte Carlo and related techniques) and 'top-down' (a historical distribution of the divergence between ex ante and ex post estimates of cost) methods agencies could use to improve their treatment of cost uncertainty. We will similarly analyze the state-of-practice, and provide recommendations, with respect to interindividual variability in the distribution of regulatory costs. Finally, we will explore various reasons why parallel treatment of uncertainty and variability in both cost and risk would not be necessary, fruitful, or meaningful, and pose counter-arguments to each reason.
- A proposal that psychometric, neuroscientific, and other researchers begin to develop a theory of 'cost perception,' to supplement and parallel the well-known theories of risk perception developed in each field over the past several decades. We will argue that although there are substantial literatures on how experts and laypeople perceive the costs of other individual and social activities (taxes, wars, personal expenditures), there is no analogous understanding of the perception of environmental regulatory costs, and how those perceptions change depending on the amount and type of information provided. We will pose a series of survey questions that we will ask later in the project about baseline perceptions of regulatory cost (e.g., whether respondents 'filter' cost estimates by assuming biases in the estimates, whether and how they construe interindividual variability in cost and its effect on their own prospects), and about how those perceptions might change as more information about uncertainty and variability is provided.
- A preliminary exploration of factors related to disciplinary orientation, training, and norms that may account for the disparate ways risk scientists and regulatory economists treat uncertainty, interindividual variability, and related phenomena. As part of this exploration, the economists and risk scientists on the project team will (independently and then in concert) attempt to enumerate the various 'invisible footnotes' that each discipline treats as implicit in order to proceed with their analyses. The goal of this exercise will be to suggest ways in which increased collaboration across the disciplinary divide might alert all involved analysts to implicit assumptions that other disciplines may not share, and to the possible benefits of adopting the perspective another discipline brings to a piece of the problem.

We have developed, based on interviews with leading regulatory economists inside and outside of government, a preliminary set of recent federal health, safety, and environmental regulations that we are analyzing for their treatment of uncertainty and variability in both cost and risk. Currently, this list includes regulations from EPA, FDA, DOT, and OSHA, although we expect to expand the set of agencies over the next year.

We have performed literature searches to identify the (relatively few) peer-reviewed publications that have explored the questions of uncertainty and variability in regulatory cost. We have also secured a copy of what may be the only grey-literature report that conducts a full Monte Carlo analysis of uncertainty in regulatory cost (a report prepared for ExxonMobil by a group of consultants, analyzing uncertainty in EPA's 'non-road diesel engine' rule, and we have recently

begun a careful analysis of the methods and inputs used in that report, to see to what extent it can be recommended as a template for analysis within (as opposed to outside of) government.

Finally, we have made progress towards selecting the two economic case studies that will demonstrate the feasibility of quantifying the interindividual variability in regulatory cost burden:

1. One of the case studies will involve a detailed investigation of the distributional impacts of a hypothetical policy. In particular, RFF will use a spatially disaggregated general equilibrium model of Land Use, Strategic Transport, and Regional Economy (LUSTRE) to simulate an effect of a carbon tax policy on the residents of a metropolitan area (LUSTRE is currently calibrated for the greater Washington, DC area). Because of the high degree of disaggregation in the model, we expect the case study to trace the mechanism of the policy impact and to shed some light on both vertical and horizontal distributional effects of the policy on the consumers.

2. Sandra Hoffmann of RFF will conduct a case study focused on the distributional consequences of regulation and their impact on consumer prices. During the next six months (in addition to continuing work on the three framing articles discussed above), she will work on identification of data sources that will inform choice of a case study. As described in the proposal, the case study will focus either on the implementation of adoption of HAACP regulations by USDA for meat inspection or of registration/reregistration decisions under the Federal Insecticide, Rodenticide and Fungicide Act (FIFRA).

Project Title: Collaborative Proposal: DRU: Incorporating Household Decision Making and Dynamic Transportation Modeling in Hurricane Evacuation: An Integrated Social Science-Engineering Approach

Proposal Number: 0826874

HSD Emphasis Area: Decision Making, Risk, and Uncertainty

Lead PI: Satish Ukkusuri, Rensselaer Polytechnic Institute
Co-PIs: Hugh Gladwin, Florida International University; Pamela Murray-Tuite, Virginia Polytechnic Institute

Research Goals:

- This interdisciplinary approach will
- Gather original data on household decision making through in-depth phone surveys;
- Develop spatial and temporal based evacuation decision models at the household levels;
- Integrate the objective parameters from household decision models within an open source agent based simulation model to estimate the effect of household decisions on traffic and evacuation decisions;
- Develop analytical optimization models incorporating objective parameters from data to determine optimal routes, departure time, and destinations (safe zones);
- Develop different scenarios to evaluate the performance of dynamic transportation models incorporated with household decision making and identify ways to influence evacuee choices, particularly with regard to leaving early enough for clearance.

To achieve these goals the following objectives will be addressed:

1. *Synthesize the state of art social science thinking about warnings, evacuation decision making, and behavioral responses.*
2. *Develop a spatial framework to map social and demographic characteristics to the household decision making.*
3. *Conduct the telephone surveys to determine the hurricane experience (including timing of evacuation and warning information considered) on evacuation decision making.*
4. *Develop a temporal framework to obtain evacuation rates with time including qualitative aspects of evacuation/forecast timing.*
5. *Integrate the warning characteristics to understand the factors that may influence evacuation compliance and timing.*
6. *Develop mathematical optimization models that incorporate time dynamics into the evacuation modeling.*
7. *Identify ways to integrate evacuation behavior (obtained from social science thinking) into optimization models to influence evacuation departure time so that all evacuees are better off as compared to the alternative.*
8. *Develop an agent based simulation model to examine the influence of household decision making on evacuation decisions and clearance timing.*
9. *Determine the most efficient way to deliver information to influence compliance and improve the evacuation process.*
10. *Identify ways to integrate the results from the research into educational programs, emergency managers, and media outlets.*

Thematic Areas:

1. Disaster Management
2. Social Science concepts related to temporal and spatial analysis of hurricane evacuation behavior
3. Engineering concepts related to transportation modeling and agent based simulation

Methodologies:
Qualitative Analysis using In-depth Interviews and Document Analysis, Statistical Data Analysis, Dynamic Network Modeling, Optimization Theory, Agent Based Simulation

Selected Recent Research Findings:
This research will start on Oct 1, 2008.

Challenges:

- Acquiring household data from different hurricanes in the form/quantities to support both disciplinary needs
- Developing analytical tools which can capture the behavior of household decision making in a holistic fashion
- Sustained graduate student interaction across disciplines/institutions

Opportunities:

- Faculty presentations to graduate students of other disciplines at their respective institutions
- Involvement of graduate and undergraduate students on critical research tasks.
- Co-authored multi-disciplinary papers/presentations
- Outreach to scholars working on similar issues in India and South America.