

Specialist Meeting on Spatial Analysis of Health Risk Perception

Upham Hotel, Santa Barbara, CA

October 10-11, 2003

Organizers

Barbara Herr Harthorn (Institute for Social, Behavioral, and Economic Research), Laury Oaks (Women's Studies), and Susan Stonich (Anthropology and Environmental Studies)

Sponsored by the Center for Spatially Integrated Social Science, University of California, Santa Barbara

Purpose

This specialist research meeting will convene an interdisciplinary group of about 15 behavioral science and health researchers whose work has centered on the areas of social risk theory, cultural constructions of health and risk, and spatial analysis of health. The purpose of the meeting will be to explore common grounds for new interdisciplinary research proposals that bring together spatial analysis with work looking at perception of health risk. People's perceptions of health risks are much more consistently associated with their behavior than are the epidemiological distribution of risk factors in populations or experts' judgments and communications about risk and risk factors. Judgments about risk acceptability have also assumed a central position in the current global geopolitical environment (e.g., in relation to food safety, location of infrastructure systems, migration and immigration, infectious diseases, and worker safety, to name only a few). Spatial analysis of health risk perception offers the possibility of helping to resolve paradoxical aspects of the social amplification of risk as well as processes of optimistic bias associated with risky behaviors, yet it is a largely unexplored arena. The format of this Research Specialist Meeting will be a 2-day meeting that alternates formal presentations with extensive discussion. Possible outcomes include networking that may lead to new collaborative research proposals to the NSF (e.g., under the new Spatial Social Science initiative) and the NIH (where the poor response of the lay public to conventional risk communication continues to be one of the most serious problems), a larger, international research conference and resultant publication(s), and dissemination of spatial analysis tools through CSISS.

Spatial Analysis of Health Risk Perception - Agenda

Friday, October 10:

8:30 - 10:30 am **Introductions** - Each participant gives a five minute summary of background and interests related to perception of risk.

10:30 - 10:45 am *Break*

10:45 - 11:30 am **Preliminary remarks** on relationships between health risk perception and space/location (led by Harthorn, Oaks, & Stonich); we will provide a set of questions for participants to consider for Saturday morning presentation; discussion.

11:30 - 1:00 am **Three 20-30 minute PowerPoint presentations:**
Mark Nichter: social and cultural aspects of risk perception
Ann Bostrom: cognitive/psychometric aspects of risk perception and communication

	Gerry Rushton: spatial analysis of health risk
1:00 - 2:00 pm	<i>Lunch</i> (at the Upham)
2:00 - 3:00 pm	Presentation on spatial analysis - Michael Goodchild / CSISS / NCGIA 1) state of the art—perception of risk and space 2) state of the art—GIS and public health 3) current boundaries of knowledge and tools
3:00 - 3:15 pm	<i>Break</i>
3:15 - 4:00 pm	Presentation on spatial statistics and health - Luc Anselin
4:00 - 4:30 pm	Demo of new spatial statistics software, GeoDa - Luc Anselin
4:30 - 5:30 pm	Discussion

Saturday, October 11:

8:30 am - 12:00 pm	Participants' presentations - 15 minutes to present ideas, problems, questions around their research and for group comment. (15 min. break mid-morning)
12:00 - 1:00 pm	<i>Lunch</i> (at the Upham)
1:00 - 4:30 pm	Wrap up session - future research directions; infrastructure needs (short mid-afternoon break)

Position Papers

Participants in the meeting were requested to share position statements prior to the meeting. These statements are attached in alphabetical order by last names of participants.

Luc Anselin
Ann Bostrom
Francesca Bray
Helen Couclelis
William Freudenburg
Arthur Getis
Michael Goodchild
Barbara Herr Harthorn
Jim Holt
Sara McLafferty

Lee Mobley
Mark Nichter
Laury Oaks
Jan Rigby
Gerry Rushton
Terre Satterfield
Elisa Sobo
Susan Stonich
Stuart Sweeney
Cynthia Warrick

Luc Anselin

Research Interests Statement

My research interests are primarily methodological, and deal with the development, implementation and application of techniques to analyze spatial and space-time data. These methods are referred to as geovisualization, exploratory spatial data analysis (or ESDA), spatial statistics or spatial econometrics. The common theme is that spatial data are typically correlated in a systematic fashion (spatial autocorrelation) as well as showing location-specific properties (spatial heterogeneity). This tends to make the application of standard statistical methods inappropriate and requires specialized techniques.

My methodological work has had two main foci. One aspect deals with new measures for local spatial autocorrelation (so-called LISA statistics) that allow for the identification of spatial clusters and spatial outliers. This is primarily an exploratory technique, useful in the first stages of an analysis, and typically carried out jointly with operations in a geographic information system. A second aspect is central to so-called spatial econometrics and includes the development of new estimation methods and specification tests that explicitly incorporate the spatial autocorrelation in the data. Currently, this work is being extended to handle patterns of space-time correlation, both in terms of visualizing these patterns, identifying clusters and outliers, as well as extending the methods of spatial econometrics to so-called panel data settings (where large cross-sections are combined with short time series) and situations where the observations are discrete (0-1 variables or counts of events).

A second aspect of my research pertains to the implementation of spatial data analytical methods in software. I was the original developer of SpaceStat, the first free-standing program to handle descriptive spatial statistics as well as spatial regression analysis (released by NCGIA in 1992). Currently I am the lead developer of GeoDa, a program designed to be an introduction to spatial data analysis, and also serve as the director of the CSISS software tools development program. As part of this, we have developed new open source software (using the Python language) to visualize the evolution of spatial autocorrelation over time, compute a range of descriptive spatial

statistics and implement spatial econometric methods. I am also closely involved with the R community of open source statistical software developers, and the RGeo initiative to coordinate, streamline and disseminate spatial statistical software.

My empirical work is rather eclectic and tends to be characterized by an attention to the spatial aspects rather than the substantive nature of the problem. This has included analyses of data on house prices as well as tropical deforestation and international conflict, the study of violent crime as well as crop yields in precision agriculture experiments. My interest in health and disease has included studies of spatial patterns in stroke mortality, the clustering of cancer incidence and mortality, and the health impacts of variations in air quality on the incidence of respiratory diseases. These studies represent similar methodological challenges, such as the issues of scale (both across space as well as over time), how to deal with the inherent variance instability of rates as estimates of risk (smoothing approaches), and the difficulty to associate the location of environmental “hazards” with the location of diseased people in the presence of mobility. Most recently, I am involved in two studies where spatial analysis is central in the measurement of health effects: the spatial pattern of cancer incidence in the Appalachian region in light of differential access to screening and diagnostics (funded by NCI); and the effect of ozone and other pollutants on the spatial pattern of hospital admissions for asthma and related respiratory ailments in the Los Angeles basin (funded by NSF/EPA).

Ann Bostrom

Current research interests:

My research focuses on mental models of hazardous processes and more generally on risk perception, communication and decisions - both personal and policy decisions. Measuring mental models, and learning more about the relationship between mental models and subjective quantitative estimates, such as probabilities, interest me in particular.

How hazards and exposures unfold in time and space strongly determines the nature of the risks people face, but not necessarily their perceptions thereof – or at least not the same way. A salient example is air quality, which varies between indoors and outdoors, and in general with proximity to sources. With EMF risk perceptions it was evident that line of sight was used by lay people to determine exposure: if you could see a transmission line, you were exposed. Right now I'm involved in several research projects (see below), all of which have interesting geospatial dimensions that are likely to play out in perceptions. I'm particularly interested in the relationships between environmental data collection and representation techniques using personal devices, risk modeling, risk perceptions, and risk reduction communications, decisions, and actions. How do the spatial attributes of perceived risks from faults (i.e., mental maps of earthquake hazards), which people don't see, compare to those of risks from air pollution, which people can see at least some of the time? How the properties of spatial representations of risks influence risk perceptions and can be used more effectively in risk communications also interests me.

Current projects:

Mid-America Earthquake (MAE) Center, Consequence Minimization thrust, Probabilistic Decision Support. The PI for this project to develop earthquake mitigation decision support is Barry Goodno (Civil & Environmental Engineering); Georgia Tech is one of multiple universities in the Center, headed by Dan Abrams at UIUC and funded by the National Science Foundation): Jim Craig (Aerospace Engineering) and I are collaborating on this project - which is one of several MAE Center projects at Georgia Tech - with doctoral students Joonam Park, Leonardo Duenas, and Steve Burns. Doctoral students Mohan Turaga and Branco Ponomariov have also contributed to this effort, through their work examining what we know about earthquake mitigation decision making and the notion of 'acceptable consequences' of earthquakes.

PERCH (Partnership for Environmental Research and Community Health) Air Quality Study (PI Michael Chang, EAS, funded by the U.S. EPA): with public policy doctoral student Mohan Turaga. We are studying risk screening models for toxics and criteria air pollutants in Escambia and Santa Rosa Counties, and looking at a range of ways of comparing these risks.

Family Decision Making and the Value of Preventing Childhood Developmental Impairment. This project is about to be funded by the U.S. EPA under the joint NSF-EPA Decision Making and Valuation for Environmental Policy program. PIs Alan Krupnick, Sandra Hoffmann at Resources for the Future are working with Wiktor Adamowicz of the University of Alberta and me to improve contingent valuation survey design, in this pilot study for the assessment of how parents value mitigating potential risks to their children from household lead paint. Mental models interviews of parents on lead and on their family decision making are a central part of this project.

Probabilities, risk judgments, and the effects of the Community Risk Scale: Together with Norman Brown at the University of Alberta, and Bob Chen and Beth Hibbs at the Centers for Disease Control and Prevention, we've tested the effects of a risk comparison framework, the Community Risk Scale, on people's subjective judgments of the relative and absolute frequencies of some causes of death, including vaccine-preventable diseases. The first part of this was funded by a Biotech-CDC seed grant. Public Policy undergrad Emily Atkinson has worked me on a replication and extension of this project, in which we have collected a small set of mental models interviews on smallpox vaccine and disease, and will also be studying subjective estimates of risk - both feelings of riskiness and probabilities of adverse events.

Undergraduate Farhan Akthar collected interviews under the guidance of Michael Chang and me to study the Atlanta Ozone Health Advisory and the degree to which there is consensus among its authors on its contents and related risk perceptions and judgments.

CSISS expert workshop, UC Santa Barbara
Health risk perception and spatial analysis
Barbara Herr Harthorn, Laury Oaks, & Susan Stonich, co-conveners
Oct 10-11, 2003

Francesca Bray, abstract, 1 August 2003

“Spatial analysis and the perception of risks associated with genetically modified organisms”

In recent research I have tried to analyse the very different attitudes of the general public in the United States and in other developed economies towards the risks associated with genetically modified crops and foods.

It is notable that in most European Union countries, as well as Japan and New Zealand (to mention just two other rich nations where public opposition to GMOs has been powerfully expressed), the general public have opposed genetically modified foods and crops (though not GM pharmaceuticals) on a number of grounds, ranging from health concerns, through environmental fears, to political principles. But the most effective weapon in the anti-GM coalition's arsenal, in all cases, has been the refusal to consume GM products. Coordinated campaigns to ban GM foods by women's groups, consumer associations, local councils and hospitals, as well as individuals lobbying supermarket chains, were the catalyst in reconfiguring government policies and industry tactics in these nations. While the anti-GM coalitions derive much of their energy and appeal from the fact that they are international and socially diverse, linking Japanese housewives' groups with Karnataka peasant rice-farmers, French cheese-makers and Peruvian microbiologists, it is action at the national level that has so far proved most effective in affecting policy and legislation. (This includes the EU where changes in Union policy towards GMOs were stimulated by a perception that public opposition was intense in a majority of the member nations.)

Whatever the wider reasons (environmental, altermondialiste) the various groups in these loose-strung coalitions may have had for opposing GMOs, the central justification which they offered for these highly effective campaigns was that GMOs have been insufficiently tested for human health risks. Not only does the prospect of health risks unite a much wider spectrum of individuals and organisations than any other dimension of risk associated with GMOs. It is also important that in the current neoliberal orthodoxy, human health risks are the one factor which all parties involved in the GMO wars accept as a legitimate concern, whether it be the World Trade Organisation, the USDA, Monsanto or Greenpeace. Individual nations like Thailand or groupings like the European Union are currently obliged to express all their reservations about approving the cultivation or importation of GMOs in terms of health risks in order to get any kind of serious hearing in US or supranational institutions. Furthermore, in this kind of calculus “health risks” themselves are very narrowly construed, largely in terms of cancer. (If

hunger, poverty and social inequality were treated as health risks, then the Codex Alimentarius would be transformed into a revolutionary weapon.)

One of the principal factors preventing the collapse of the GM industry through its dramatic ups and downs over the last decade has been the lack of any kind of opposition by US consumers. As more and more products on regular sale in US supermarkets incorporate GM ingredients, not only has the US consumer market provided a secure and expanding outlet for GM corporations and for farmers growing GM crops, but the acceptance of GM foods by the US public, and the ostensible absence of any negative impact on their health, serve as an increasingly powerful justification, aggressively pushed by the US administration as well as the GM industry, to argue that there is no basis for opposition to or control of these products.

In the United States, although several polls have shown that a large percentage (over 80%) of respondents would like in principle to see GM food products labelled so that they could make their own choice about whether or not to consume them, the general public is largely unaware of the ubiquity of GM ingredients in their foods, and efforts by organisations like Greenpeace, Cal-PIRG or the Union of Concerned Scientists to organise consumer pressure, for instance for more testing, better controls, or even labelling, have made little headway. One reason for the low level of opposition to the incorporation of GMOs into everyday life in the US appears to be the unusually high degree of trust in government regulatory bodies. Another is undoubtedly the role and structure of the media: unlike in Europe or Japan, in the US most of the information or opinions broadcast or printed on GMOs come directly from press releases given out by, or individuals paid by, the interested industries and institutions. A further factor is probably the technophilia characteristic of American society. Finally, although a couple of scandals (including StarLink) appeared likely at the time to raise the consciousness of the public about possible health risks, it is true that so far no accepted evidence for such risks has been produced.

In spatial terms, I have hitherto thought about GMOs in terms of (1) global networks and concentrations (biotech industries concentrated in the US and Europe; regulatory bodies ditto; opponents scattered through North and South with key figures circulating to mobilise action; the role of the internet in bridging geographical barriers to cooperation ...). (2) The interplay between national and supranational action and reaction (consumer opposition coordinated within a nation; the positions taken by national media; the often ambivalent place of biotechnology in national government policy; questions of the rights of nations or blocs to protect their own populations in the face of regulations imposed by supranational organisations ...).

My question to my colleagues here would be: what new kinds of question about GMO issues would spatial analysis of the kind that you do allow me to ask?

Spatial Analysis and Health Risk Perception

Leo R. Chavez, Anthropology, University of California, Irvine

My research has focused on issues related to the immigrant experience. A key area of my research has been on access to medical services, especially for immigrants from Mexico and Central America, and more recently, cultural and social factors (including risk perceptions) in breast and cervical cancer control among Latinas and Anglo women. My research also examines other areas of the immigrant experience, including labor market participation, family structure, citizenship/immigration status issues, and media representations of immigrants and immigration. At the present time, I am engaged in a research project on the social integration of what is being called the “second generation,” the children of immigrants born or raised since young in the United States, ore more specifically, the five counties in the greater Los Angeles area.

Space and location are significantly important for my research. Immigrants and their children are spatially located, and their spatial location and mobility provide important insights into social integration, access to medical services, economic mobility, labor demand, housing affordability, and a host of variables. At the present time, I rely on census information to help me understand the populations I study and their spatial locations. The mapping publications of Professor James P. Allen have been most useful in this regard. However, greater facility with GIS methodologies and other geographic analysis methods would be most useful in the work I do. Space, place and people are linked in the conceptual framework of most anthropologists, even when people move across spaces and become embedded in new places.

Helen Couclelis

As a geographer interested in how space, time and events intersect with human behavior I feel challenged by the apparent intractability of the risks of bioterrorism and the major and novel issues of risk perception it raises. Health risks are generally associated either with particular kinds of environments or with individuals in particular kinds of situations, professions, behaviors, or states of health. Often environmental and individual health risks reinforce each other (e.g, a person with asthma in a smoggy environment). Space and time are clearly relevant dimensions in all these cases. Environmental health hazards usually have a spatial and temporal footprint that may be as fixed and well defined as a contaminated industrial site or as ill defined as the spatiotemporal incidence of the next extreme heat wave. Health risks associated with individuals move in space and time with the people who carry them and may be studied as spatiotemporal trajectories or as networks of contacts, especially in the case of contagious diseases. For many years spatial analysis has been used to study the distribution of health risk in space and time while behavioral geographers have looked at how the perception of, and response to risk by people correlates with its actual spatial distribution (not very well!).

Recently people in this country and elsewhere have been faced with health risks whereby both the spatiotemporal dimensions of the hazard and the characteristics of the at-risk population appear to be completely indefinable until after the fact. While risks of the conventional kind are frequently underestimated, risks of this more recent variety have the potential to lead to widespread panic quite out of proportion with the actual threat to the health of any particular individual. Thus the handful of deaths and non-fatal infections from anthrax in the winter of 2001-02 led to major disruptions in the country's functioning resulting in substantial psychological as well as economic costs. Bioterrorism, like most other forms of terrorism, works by creating the perception that anyone, anywhere, any time could be the next victim. What could be the spatial analysis approach to this kind of indeterminacy? I don't know the answer but hope that some other participants in this workshop will be interested in exploring this issue.

Bill Freudenburg
Statement of interest

In essence, there are three main ways in which space is intrinsic to my work.

First, and most obviously, much of my work has had to do with specific communities and regions, and the ways in which they have responded to environmental and technological threats and opportunities. Each one of those communities is profoundly connected to its own setting, for reasons that range from the geologically ancient (e.g., presence of oil deposits or of rock that looks "favorable" for nuclear waste disposal), to the reasonably current (e.g., present-day debates over how forest policy ought to be managed, future plans for amenity-related shore-front developments).

Second, I have often looked at relationships that are spatially structured within a given community -- involving for example connections or conflicts between established and newly developed parts of town, or between those who live in trailer courts and those who live in the expensive houses up on the hill.

Third, and more quantitatively, I have been doing some work in recent years with Frank Howell (a sociologist at Mississippi State University), looking at connections between inequality, policy, and environmental degradation. Our findings deserve to be seen as preliminary for now, but we do seem to find some evidence that the relationships between pollution and inequality are different for the southeastern U.S. than for the rest of the country.

Arthur Getis

A. Current and Prospective Research Interests

I am engaged in a series of related research projects in fields as diverse as demography, disease transmission, and economic well being. This work is held together by my consuming interest: the role of spatial patterns for understanding social and economic processes and the development of techniques for spatial analysis. A component of each of the research projects is spatial. With the subject matter of this meeting in mind, let me briefly address the spatial research embodied in the disease transmission projects.

Together with colleagues at UC Davis and in Peru and Thailand, we are attempting to better understand the transmission of dengue fever. In a nutshell, transmission takes place when a female *Aedes aegypti* mosquito blood-feeds on a viremic human, one who harbors one or more of the four dengue viruses, and then soon after blood-feeds on a human who was never before infected by the particular virus held by the mosquito.

The Peru study data has been collected, but the Thailand study is only now getting underway. For Peru, several research papers have been written and several more are planned. The first papers concern the entomological characteristics of disease transmission. The papers now being prepared investigate the serological characteristics of disease transmission and the interaction of entomology and serology.

Here, I will report briefly on some aspects of the entomological research, which represents an assessment of disease risk. Entomology includes a study of the life history strategies of the mosquito vector and a study of the human propensities to facilitate disease transmission. For all practical purposes, only the *Aedes aegypti* is the vector of dengue, and only humans are the sources of the blood the mosquitoes need for oviposition (egg laying). Thus, our study is of the symbiotic relationship between insect and human. As one might expect, given the short range of flight of the mosquito (it flies only about 50 meters from its pupa site) and short life span (about 12 days), the possible susceptible humans will be found in areas near oviposition sites.

Perhaps the chief finding of our studies points toward individual households, more or less spatially separated from other households, as the major source for mosquitoes. More often than not, these households contain elevated numbers of unlidged, outdoor, water-holding containers. Although we know that the spatial aspects of the pattern of mosquitoes (adult and immature) and the pattern of humans (particularly children; who are most likely not to have been infected by any dengue virus) are the key to understanding the transmission of the disease, we have not been able to show a direct link between mosquitoes and infected individuals.

It is for that reason that we have engaged in the Thailand project. In that country, we hope to collect data in such a way that the link between serological and entomological characteristics of a household are less subtle and more obvious. Since the beginning of

the Peruvian study five years ago, new technology has made it possible to identify the existence of a viremic individual within 24 hours after becoming viremic. In addition, our sampling scheme goes beyond the household to consider other possible sites for disease transmission.

B. New Types of Spatial Analysis

In our Peruvian study, we engaged in a series of what may be called descriptive spatial pattern identifiers. These included K-functions (global statistics) and G_i clustering statistics (local statistics). These enabled us to identify statistically significant clusters of entomological or serological variables. From these, we could assign probabilities to the likelihood that a particular household might become a site for disease transmission. While we engaged in this project, several other spatial analytical devices were developed but not thoroughly explored. These include spatial filtering and AMOEBA (A Multi-directional Optimal Ecotope-Based Analysis), and spatial modeling using compartments. All of these will be employed in the Thailand study. Spatial filtering allows for the identification of that part of a variable unaffected by spatial association with near neighbors and that part affected by spatial association. AMOEBA allows for the detailed creation of the spatial weights matrix, now a basic part of the regression modeling which requires georeferenced variables. The compartment models include specifications for disease transmission.

Michael F. Goodchild

Space and time seem to play an essential role in health risk perception. A hazard has a footprint in space and time – at any point in time the footprint might be represented as an area, though in some cases a point or line might be adequate, and over time the footprint might move to form a track or trajectory. The footprint of SARS infection risk over the past twelve months is particularly complex, and might be better conceived as a space-time continuous field, with risk quantified at any point and time, rather than as a collection of discrete, moving objects.

My perception of risk is determined by the interaction between the risk footprint and my own location, which is also a complex pattern in space and time. Some hazards require simply that I be located inside the footprint to perceive the risk – earthquake risk is a case in point. In other cases perception of risk is determined by relative location, and by my expectations about distance decay. Some risks require physical contact, or co-location, while in other cases physical proximity is sufficient. I know, for example, that AIDS requires physical contact and am unlikely to feel at risk when close to AIDS infection, but in the SARS case simply being in the same city as SARS infection has led to the perception of risk.

It is clear also that the perception of health risk is to some extent determined by the media, which have their own spatial dimensions. It is still possible in today's information-rich and media-dominated world for entire cultures to be effectively isolated, an obvious example being North Korea. Awareness of proximity to risk is also to some degree media-controlled: I am far more aware, for example, of proximity to SARS risk than to risks of similar magnitude in the Western US from bubonic plague or Hanta virus.

It's obvious that the tools of GIS have a major role to play in handling the data needed to understand these dimensions of risk perception. Less obvious is the fact that the relevant data supply is rapidly improving. Substantial data sets are already available on space-time behavior (tracks) of individuals at spatial resolutions of meters, and temporal resolutions of minutes. It is estimated that there are already 20 million vehicles on US roads with GPS installed, allowing measurement of position at rates as high as 1 Hz. There is interesting research to be done on the parsing of such tracks, to infer behaviors, activities, and events from positions, velocities, and accelerations. For some types of health risk, such as those deriving from environmental exposure, it is clear that much larger extents are required in space and time, and that resolutions can be much coarser.

This optimistic picture of tools and data is not matched, however, by the situation with respect to methods and models. Consider for example a set of tracks for a sample of people over the course of a diurnal cycle. At any fixed time the tracks create a point pattern, for which we have abundant models and methods available. But for tracks we appear to lack even the simplest null hypothesis – what do we mean, exactly, by a random track, and what do we expect about the tracks of individuals? We have not even begun to develop the appropriate concepts, terms, and analytic tools (though see recent work on this by Harvey Miller). Although it is tempting to think of visualizing tracks as

three-dimensional structures, using the vertical dimension to represent time, we also lack effective ways of displaying tracks to expose systematic and anomalous behaviors – not surprisingly given the dearth of models and analytic methods.

Hopefully the new abundance of tracking data will lead to a surge of interest in defining appropriate methods and hypotheses. Tracking data also raises a number of social issues: under what circumstances will people allow themselves to be tracked, what constraints will regulators place on tracking data, and will researchers be allowed access to individual tracks, or only to suitably anonymized aggregates?

Barbara Herr Harthorn

Statement of research interests

CSISS specialist meeting on Health Risk Perception and Spatial Analysis

My research centers on the social production of health inequality, particularly the ways that cultural and social processes affect gendered and racialized disparate health outcomes. I have been involved in cultural anthropological field research related to health inequities among urban migrants working as barmaids in Uganda, native Hawaiian families in Honolulu, Melanesian Fijian women and men in three communities on a small, rural island in Lau, Fiji, deinstitutionalized mentally retarded adults in urban Los Angeles, primary care physicians working as gatekeepers to mental health care in Santa Barbara, and, most recently, Mexican-origin agricultural workers and their families in rural Santa Barbara County, California.

This latter research has focused on aspects of farmworker health in central coastal California. This work has included a study of the public health system's and private nonprofit organizations' roles in the diagnosis and treatment of tuberculosis among farmworkers, and a prospective study of farmworker maternal and newborn health. Both studies use an environmental justice approach to examine links between the full array of farmworker living and working conditions, health care access, health care delivery practices, and particular health consequences and treatment outcomes. As an offshoot of these studies, I have also embarked on an historical study to track the emergence of racialized discourse in biomedicine and public health about the etiology and treatment of infectious disease among Latino immigrants in California in the first 3 decades of the 20th century. I am now in the planning stages for a larger-scale project that will examine both women and men in the farmworker community in California, looking at a number of issues related to immigration, health assimilation, stress, and illness. This work attempts to capture (sociologically) the local processes that underpin the population-wide production of accelerating health inequality in the US among the working poor. An additional on-going study has examined a local case of community conflict over pesticide drift and perceived negative health impacts among Anglo suburban residents.

My interests in risk exposures and perception of risk have emerged from this research. Farmworkers arguably represent an archetype for workplace hazard and risk exposure. Yet, in the communities around us in California, public discourse about risks from exposures to agricultural chemicals has centered on downstream food consumers, suburban home owners on the agricultural-urban interface, and children in public schools. For the frontline exposed, immigrant and often undocumented, the social processes of risk assessment are explicitly distinct, fulfilling culture and risk experts Mary Douglas and Dorothy Nelkins' judgments about the 'forensic uses of risk acceptability' in a global society. One promising method to complicate (and hence disrupt) these disparities seems to me to be spatial analysis.

In recent years a number of leading scholars in anthropology, sociology, and decision theory have coalesced understandings about the socially constructed nature of judgments about risk, and how such judgments vary according to a number of key social, political

and economic variables. Health risk judgments in particular have assumed a position of centrality in the current global geopolitical environment, and the renewed emphasis on behavioral research at the NIH in determining solutions to thorny health assessment and education problems largely stems from widely reported but poorly understood divergences of experts' and lay persons' judgments about health risks (e.g., Sobo 1995; Harthorn and Oaks 2003; Pidgeon, Kasperson, and Slovic 2003). The spatial (and spatial/temporal) analysis of risk perception is a largely unexplored arena that offers much for expanding understandings of perception of risk. The most sophisticated psychometric studies of risk perception among American respondents (see Slovic 2000; Slovic, Fischhoff and Lichtenstein 2000) now assess effects of as many as 90 hazards and 18 different parameters of risk characteristics, but spatial analysis as an explicit approach is missing

The attractions to me of bringing GIS to this set of problems are several. On the most basic level, the ability to visualize data and spatial patterns offers a powerful tool for education and research. This capacity links directly to the development of Public Participation GIS (PPGIS) and should interest anthropologists, whose work often involves participatory engagement with lay/community members. Through PPGIS we aim to make complex health data patterns understandable to affected community members.

Additionally, although an underdeveloped area of GIS, the development of a "pluralistic GIS," one that can incorporate and represent multiple realities and particularly what has been called socially differentiated knowledge, has been an acknowledged challenge for a number of years (e.g., Harris and Weiner 1996). The possibility of representing spatially the multiple perceptions of different units of the population (or even the same sectors over time) would seem to offer policy makers and community members the chance to understand the patterns underlying risk avoidance, risk amplification, and other classic dilemmas in risk analysis. The perception of health risk presents a particularly sensitive and important 'multiple reality,' one that scholars have shown to be the key determinant of community and individual response to exposure to health hazards.

And finally, the ability to layer data at different scales in a GIS offers great promise to those of us in anthropology and sociology who are attempting to represent the relationships between complex local processes and data on the one hand and large-scale macro forces such as globalization, regional economic transformation, and transnational migration on the other.

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Current and Prospective Research Interests

My current research interests are mainly the product by my PhD dissertation, “The Use of a Geographic Information System (GIS) and Satellite Remote Sensing for Small-Area Mortality Analysis” (University of Georgia, under the direction of C.P. Lo, 2003). From this research, my interests are in the integration of GIS and satellite remote sensing for chronic disease surveillance and research; small-area analysis of risk factors related to chronic disease morbidity and mortality; dasymetric mapping of population density and areal interpolation of socio-demographic data; and the relationship between the social and physical environment and health.

Based on work that I am involved with at the Centers for Disease Control and Prevention (CDC), my emerging research interests include: the social determinants of health; summary measures of population health; and the use of multi-level modeling to better understand the contribution of individual-level and area-level (i.e., “place”) effects on health-related risk behaviors and on health outcomes. Specifically, I am actively involved in CDC’s Social Determinants of Health Workgroup, which has recently funded (FY03) projects to develop a consensus set of scalable indicators of social health for the United States and individual states (and potentially applicable to sub-state administrative units); an update to the Community Health Status Indicators database (originally funded by HRSA); and the development of a model Regional Health Status Database, which will contain a collection of social, environmental, and health-related variables, for health-planning at the municipal/neighborhood level. I am tangentially interested in the development and application of summary measures of population health, to include preference-based measures such as Disability-Adjusted Life Years (DALYs) and other non-preference-based measures. I am also leading the effort to produce a series of disease condition-specific risk factor atlases, which are to be based on almost twenty years of data from the Behavioral Risk Factor Surveillance System (BRFSS). I would like to develop skills in applying multi-level modeling techniques, and I wish to improve my knowledge and abilities in spatial analysis techniques.

Interests Related to Space and Location

My interests in space and location are mainly with the contextual (“place”) effects on health risk behaviors and health outcomes (specifically chronic diseases). I have done some ecological analysis, but fully understand the inherent limitations to this approach. Therefore, I wish to become more conversant and skilled in the application of multi-level techniques.

Current (Perceived) Limitations to Spatial Analysis

I perceive two main limitations to spatial analysis in my work. First, is the relative lack of point-level health-related data. Although there are long-established disease registries for cancer, this is the exception (at least at the national scale) for other chronic diseases. Issues of confidentiality may continue to be an impediment to the acquisition of individual-level information, although techniques exist for analyzing and displaying individual-level data without compromising individual identities (e.g., Armstrong *et al*, 1999). A promising development is the publication of Healthy People 2010 Objective 23-3: “Increase the proportion of all major national, State, and local health data systems that use geocoding to promote nationwide use of geographic information systems (GIS) at all levels.” (U.S. Department of Health and Human Services, 2000).

A second (and lesser) limitation to spatial analysis is the relative lack of geographic information systems with fully-integrated spatial statistical capabilities. This limitation has been offset by the recent availability of spatial statistical applications that can be loosely-coupled with commercial GIS (e.g., Crimestat II, SaTScan 3.0, and GeoDa 0.9.3); and the availability of other packages such as S-Plus for ArcView 3.x.

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My research interests include the use of spatial analysis methods and geographic information systems to analyze health and social inequalities in cities and to evaluate geographical access to health care services and employment opportunities for women and minorities. I am currently exploring the impacts of socio-demographic changes such as immigration on geographical access to prenatal care services and geographical inequalities in reproductive health outcomes in New York City. This work attempts to 'decompose' changes in health status indicators for small geographic areas into components that represent: (1) the effects of demographic, compositional change and (2) improvement or deterioration in health status within a 'fixed' population. A second area of current and prospective research interest is the use of digital geographic information and GIS in community-based efforts to improve health. Through a series of case studies, I will examine how community groups make sense of geographic information about health and the environment; how geographic information and GIS contribute to community mobilization around health issues; and community groups' understanding of and need for spatial analysis tools.

Role of GIS/spatial analysis in health risk analysis and perception

Understanding health risks involves consideration of people, the environment (both built and natural), and the flows of people and environmental quality through space and time. Increasingly GIS and spatial analysis methods are being used to map and model environmental hazards and risks and to estimate population exposures to such hazards and risks. Detailed geographic data and rigorous spatial analysis methods exist for understanding the environmental component of health risk. For example, we can model fairly accurately the dispersal of air and water contaminants through space and time from point and non-point sources. Some public health researchers are using mobile devices to collect real-time environmental exposure information yielding rich spatio-temporal environmental data sets.

In comparison to the environmental component, the 'people' component of health risk is much less well-developed in GIS and spatial analysis research. Incorporating people in spatial analysis tools for health risk assessment involves several key issues. First, we need to grapple with population diversity in relation to age, gender, race/ethnicity, class and so on. Although two people live in the same place, their experiences of that place often differ markedly with concomitant effect on health and well-being. Furthermore, there are also important differences in immune response so that the effect on health of a given environmental exposure varies among people. Many spatial analysis tools to analyze, for example, disease clustering have been slow to incorporate population covariates that might influence the risk of ill-health.

Second, better tools are needed to model people's activity patterns and movements through space and time, at different geographical scales. For many people, the residence is not the primary source of exposure to environmental contaminants and to the human interactions that underpin many infectious health problems. Occupational risks have long been recognized, but there are also important exposures in recreational, social, educational, institutional and transportation settings. Thus, health risks are rooted in our activity and mobility patterns in space and time. Research shows that activity patterns are highly differentiated on the basis of age, gender, class and race/ethnicity. Social networks and interactions are also highly differentiated. Researchers are just beginning to develop spatial analysis tools for measuring, visualizing and modeling space-time activity patterns, and we know little about the implications for spatial analysis of health inequalities.

Finally, it's important to think broadly about the roles of geographic information and GIS in the context of public health policy and efforts by communities to improve health. Community groups have access to a wide array of geographic information on disease rates, demographic trends, environmental hazards, health care quality, etc and to rudimentary spatial analytic tools for exploring such information. How do communities perceive and use this information? How does it affect their interactions with state and local health departments and their use of health services? How are public health departments and health care providers using geographic information and what types of information and tools do they need? What are the long-term effects on spatial organization and quality of health services and mitigation of health risks?

Lee Mobley: Areas of Research Interest

Areas of research interest include:

- spatially-enabled analysis of variation in: treatment effectiveness, regional healthcare quality, and healthcare outcomes and access;
- combined behavioral and geo-demographic risk assessment in understanding the incidence and prevalence of disease;
- corrections for spatial multiplier effects;
- examining the potential for spatial regression in hierarchical disease modeling.

Some examples of spatial analyses I have done and challenges faced in my current work that would benefit from expert knowledge are summarized below, in three main areas.

1. Spatial Analysis of Survey Data

As a specialist in market economic theory, I have been interested for some time in how market environment – including supply and demand factors, and their interactions – can impact economic outcomes such as costs, prices, and access to care for the poor and uninsured. In the early part of my career as a health economist, I had access to good data on hospitals, and focused a lot of research effort on understanding the supply side of the market. Supply-side market factors include aspects such as provider shortages, provider market power and its impacts on economic outcomes, provider attitudes about managed care, provider acceptance of managed care rates and fees, restrictive hospital admissions practices that distort location of services received, and selective contracting by managed care payers that results in reduced choice of provider among the insured. During that period, I was not able to include any really good, micro-level, demand-side data.

Since moving to RTI, I now have access to very good demand-side data, mostly from Medicare claims files and Medicare surveys – so my recent work has focused more on the elderly. I am now very interested in understanding more about social variation and how it impacts healthcare outcomes. In order to model this, I have found that it is very important to account for variation in the supply-side market environment, which forms part of the context for behavioral health decisions. (The same person may make different choices if placed in a very different market environment!) I have applied spatial cluster analysis to rates of dissatisfaction reported by Medicare beneficiaries who disenrolled from Medicare HMOs for various reasons. The Reasons include: access reasons, cost reasons, limited doctor choice, limited drug coverage, and information problems. These Reasons ‘hot spots’ cluster in different places – suggesting that specific plan-level and or market-level factors may be causing the observed coincidence of complaints. I have subsequently applied an ad-hoc procedure to analyze the underlying contextual factors – simple t-tests comparing means for variables in hot spots versus other places. Significant differences are found in market factors across the hotspots and other places, which have interesting policy implications. However, I am not confident about this ad-hoc t-test approach for several reasons. First, the survey data are stratified samples, not random, and I can’t comprehend how survey design weights might confound the identification of clusters or the t-tests themselves. I don’t know how to incorporate the sample design weights into the cluster analysis; this would ‘explode’ the sample into a nationally-representative sample. The sample design draws the same number of respondents from

each plan, regardless of plan size, so the sample design weights also account for uncertainty related to n/N . Spatial clusters are identified on the unweighted sample data using closest neighbor spatial weights, and results (hotspots) seem robust to whether sparser counties (those with fewer respondents) are included or excluded from the analysis. But while the clusters identified seem robust to this source of spatial heterogeneity in the Reasons rates, I don't know whether I have violated a basic premise of the local spatial autocorrelation methodology by employing it on data that are likely *not* to be stable over time. An assessment by a spatial econometrician of the capabilities and limitations of local spatial autocorrelation tests for analysis of survey data would be very helpful to me.

2. Spatial Interaction Among Individuals

The interaction among individuals, and the impact of peers and local cultural enclaves on personal behavior, is another intriguing area that is very difficult to model. Agent-based simulation models have been used to parameterize cohorts of individuals and to interact them with their geographic environment (1). These models are somewhat unsatisfactory to me, because they do not readily allow assessment of statistical significance or conduction of statistical inference. Thus I have been intrigued by the idea of morphing a spatial econometric model of spillovers so as to account for interactions among people. I believe this would require establishing spatial weights based on economic or cultural similarity variables (to capture peer/culture effects) similar to the 'economic weights' proposed by Case, Rosen, and Hines (2). The problem is that such an approach would introduce spatial heterogeneity that could confound assessment of spillover effects, and the method might also be susceptible to endogeneity bias. However, I think there is some merit in attempting to model inter-personal interaction in a way that accounts for contextual factors, so I think spatial spillover components in hierarchical disease models might be quite useful. If there is anyone out there doing work like this, I would be most interested in seeing it. The closest I've found is work by Michael Oakes (3).

3. Person-Specific Measures of Access Impedance

For some time I have also been intrigued by the challenge posed by attempts to measure access impedance. It seems to me that such measures should be individual-specific. Individual-specific measures would help explain why some women are diagnosed at Stage IV cancer, and others are diagnosed at Stage I, for example. I am most interested in developing impedance measures that combine several factors into a single, individual-specific score. Some limited work I have done using 'map algebra' tempts me to believe that various factors could be summed or aggregated cartographically. This is appealing because it opens the possibility of combining raster-based data layers with vector-based data layers. Ideally, we could create a score for an individual that reflected topographic impedance factors as well as market contextual and cultural/social contextual factors. I think of this hypothetical score as a measure of the true 'economic distance', a measure of the impedance faced by an individual in the production of his or her health.

(1) For example, The Santa Fe Institute has been very involved in using agent-based simulation, and have a few people working on modeling the spread of epidemics: <http://www.santafe.edu/sfi/publications/wpabstract/199901004>

(2) Case, A. and Rosen, H. and Hines, J., “Budget Spillovers and Fiscal Policy Interdependence: Evidence From the States”, Journal of Public Economics, v 52 (1993), pp 285-307.

(3) Michael Oakes’ paper entitled “ The Mis-Estimation of Neighborhood Effects: Causal Inference in Multilevel Models with Observational Data” will be presented at the American Statistical Association – Health Policy Statistics Section conference (International Conference on Health Policy Research: Methodological Issues in Health Services and Outcomes Research) in Chicago. The paper will be presented in an organized session (Saturday October 18 at 2:15 PM) entitled *Applications of Spatial Econometrics to Healthcare*.

Mark Nichter précis for SB

My ongoing research interests relate to the interface between anthropology, public health, and consumer behavior; ecosocial epidemiology and political ecology; changing perceptions of risk and vulnerability and the way they are mediated by harm reduction practices; and the politics of responsibility. At present I am actively involved in research on tobacco use and nicotine dependence in the US as well as in South and South East Asia, pharmaceutical use and practice, and the study of infectious and vector borne illness.

I have no experience conducting spatial analysis. In principle I could see this type of analysis assisting me map a population's exposure to a host of things (contagious disease, vector breeding sites, density of cigarette advertisements/ distribution points, fast food chains), the availability of resources (food stores, clinics, pharmacies), syndemic patterns of illness associated with particular contextual/environmental factors, and environments of risk as well as resilience. This type of tool might be useful in studies of health inequity. Whether I directly use it or not, I want to know enough about the methodology to introduce it to students as a valuable tool.

CSISS Expert Workshop, UC Santa Barbara
Spatial Analysis and Health Risk Perception
October 10-11, 2003

Laury Oaks, précis

Spatial Analysis and the Gendered Dimensions of Health Risk Perception

My current research focuses on understanding varied social, cultural, and political dimensions of reproductive health risks, with particular attention to the gendered nature of health risks and health perceptions. I am primarily interested in how different constituencies perceive and represent health risks, and how health experts and advocates target specific populations with health risk messages.

In the past, I have conducted research comparing health experts' and pregnant women's perceptions of the fetal health risks of cigarette smoking during pregnancy, finding race, class, and generational differences in risk assessments. My work has also argued that the messages featured in some anti-smoking health risk warnings about fetal personhood parallel anti-abortion advocates' political goal of creating "the unborn" as a vulnerable population in need of state protection. Further, anti-smoking messages targeting pregnant and pre-pregnant women create specific ideals of motherhood that reinforce gendered assumptions about parental responsibilities.

Another research project similarly juxtaposes perceptions of risk, in this case focusing on health activists. Since the mid-1990s, anti-abortion advocates in the US have successfully lobbied in a number of states to pass women's "right to know" laws, which stipulate that a woman contemplating abortion must be counseled that abortion is linked with an increased breast cancer risk. The abortion-breast cancer risk campaign is analytically compelling because it brings together dissent over abortion and widespread fear about the causes of breast cancer. Breast cancer activists promote their own health risk messages, aimed at increasing research dollars and persuading women to seek early detection and intervention. An underlying theme of these and other health risk messages is that the appropriate and morally upstanding action that informed women must take is to avoid or decrease risk. Individual women's pregnancy decision-making, however, does not take only breast cancer risk into account. Indeed, taking into account the medical risks of pregnancy reveals an inadequate risk-benefit analysis as part of the anti-abortion logic that one should continue a pregnancy to reduce one's breast cancer risk.

I am currently pursuing research on another dimension of gender and health risk: the development and potential future marketing of new male hormonal contraceptives. Advocates of such contraceptives face two distinct markets: men in areas where "population control" is emphasized and areas where men's "reproductive choice" is emphasized. The marketing and distribution of male contraceptives will need to address health risks incurred by use of the "male pill" to both men and their women sexual, including the risk of unintended pregnancy and sexually transmitted infections. Depending on cultural contexts, the "male pill" also demands scrutiny regarding who is

targeted as a potential user (by class, race/ethnicity, religion, etc.) and, politically and demographically, why.

I would like to pose the question of how to apply spatial analysis to gendered dimensions of health risk perception. Specific questions include: a) Are there gender differences in perception of health risk that show spatial patterning (e.g., demographically, in terms of where people live, perhaps particularly regarding head of household, household make-up, and poverty)?; b) Does where the health risk statements are made affect gendered judgments about risk?; and c) Is gendered perception of risk that linked with gendered differences in health and/or health behaviors, and is there a spatial link to such differences?

Nick Pidgeon: Risk and GIS Workshop, Santa Barbara, October 2003

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Nick Pidgeon is a psychologist and Professor of Environmental Sciences, University of East Anglia, Norwich and Director of the Centre for Environmental Risk based in the School. He is also principal grant holder and Programme Director for a major research effort sponsored by the Leverhulme Trust on *Understanding Risk* (www.uea.ac.uk/env/pur). He was first author of Chapter 5 in the influential 1992 Royal Society report on risk, and subsequently served on the steering committee of ESRC's Risk and Human Behaviour programme (1994-2000). Currently a member of the UK National Radiological Protection Board *Risk, Science and Society* Advisory Committee, and the Royal Society/Royal Academy of Engineering inquiry into nanotechnology. He has published and edited a range of journal articles on human-technical accidents, as well as on perception and communication of risk. Co-author of *Man-Made Disasters*, 2nd Edn (1997, Butterworth-Heinemann with Barry Turner), and *The Social Amplification of Risk* (2003, Cambridge with Paul Slovic and Roger Kasperson).

His work on risk, place and spatial analysis is being conducted in collaboration with other members of the team at UEA (in particular Karen Bickerstaff, Peter Simmons, Pat Cox and Iain Lake) and has two components.

(A) In 2001 we conducted a mixed methods study of public attitudes to the UK Foot and Mouth disease outbreak. This involved a questionnaire survey and qualitative focus groups, conducted in two places: the City of Norwich and the Town of Bude in Cornwall. The former location was not affected by the outbreak but the latter was very close to major disease cases. The discourse in the focus groups in particular evidenced different talk regarding government handling of the crisis. In particular, participants in Bude stressed themes of identity, marginalisation and disempowerment. I hope to discuss the theoretical implications of some of these results in relation to emerging ideas about space, place and risk. The work has also led to an analysis of the different risk management strategies to combating the disease, and how place held a particular importance for local decision makers and vets but less so for the national (UK) government scientists in overall charge of the culling strategy.

(B) Ongoing work on public risk perceptions of the health effects of ionising radiation and electromagnetic fields is investigating hazards with a particular spatial component to exposure (radon and overhead power-lines respectively). Interview work, using the mental models technique, has already gathered information from affected and non-affected people for both hazards. During 2004 we aim to use GIS techniques, alongside standard psychometric survey methodologies, to compare risk perceptions and vulnerability data. Accordingly I hope to be able to discuss some of

the design issues involved with participants at the workshop, together with opportunities and pitfalls.

Overall I have an interest in the use of multiple (mixed) social science methodologies and data triangulation for addressing a range of environmental questions, and have also written on the use of the 'grounded theory' approach for contextually-based qualitative environmental research. The interface of GIS and traditional risk perception methodologies appears to offer considerable promise for novel and innovative work in what is already a heavily interdisciplinary domain.

Completed and ongoing research projects include: Research Programme on *Understanding Risk: Public Perception, Trust in Institutions and Stakeholder Participation in Public Policy* (2001– 2005, Leverhulme Trust); *Public Perception of and Trust in the HSE as a Regulator* (2000 – 2002, Health and Safety Executive); *Expert and Public Risk Perceptions of the Health Effects of Ionising Radiation and Electromagnetic Fields: A Mental Models Approach* (2001 - 2004, Department of Health).

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Thought-Piece: Jan Rigby

My recent academic background can probably be described as spatial epidemiology, involving the application of geographical approaches to the description of disease patterns, and to attempts to model those patterns and underlying processes. My PhD thesis explored breast cancer data, which was somewhat reluctant to produce spatial patterns at various scales, or to be modelled using census variables. It offers the geographer further headaches concerning disease latency, migration issues, data aggregation... We are all aware of these data problems.

The thesis also involved in-depth interviews with women both with, and without, breast cancer to collect individual life histories. These were explored from a basic epidemiological perspective, and mostly in an aspatial format. Despite there being considerable information resources available about this particular disease, the level of awareness of these women was often quite low.

In New Zealand we have just completed an initial piece of work for the National Screening Unit, looking at the uptake of women's screening services (for both breast and cervical cancers). Here we find that incidence of, and mortality from, those cancers are higher in women of Maori and Pacific Island ethnicities than those who are termed 'white European'. [In addition, Maori mortality from lung cancer is among the highest in the world.] Yet the uptake rates of the screening services show that they seem to be failing Maori and Pacific Island women. Hence those who are statistically most 'at risk' are using the preventive services least. Further, although income is a major barrier for some women to access healthcare, the differences are not explained by deprivation, and recent qualitative research suggests that cultural beliefs and practices do not account for the differences either. We do know that, at a regional level, the higher the proportion of Maori women who live in an area, the higher the proportion of those women who attend for screening.

Hence one major question for me is how we can build in complex individual viewpoints and knowledges to understand what people know about risks to their health.

Further, to what extent can we use geography to convey health risks both to the policy makers and to the public? New Zealand is overdue an epidemic of measles, and the immunisation status of the population is both poor, and poorly known. If we can improve the quality of the data, how do we convey its meaning to those people whose children are at risk, and how do we ascertain their understanding of that risk?

Statement for Research Workshop on Spatial Analysis of Health Risk Perception

Gerard Rushton, The University of Iowa

I am a geographer who for the past decade has worked on problems of small-area analysis of spatial patterns of disease. I am intrigued by the idea that the dominant theories and methods in this area presuppose that measures of disease risk have been made for small areas whereas health risks rarely, if ever, coincide with the areas for which these measures are made. Thus I start with a concern for this fundamental spatial disconnect and I ask why the literature that measures health risks has developed in this way. I also ask whether it should be a source of concern that we frequently define health risk for small areas when we have evidence that “real” risk is spatially distributed so differently. I think, for example, that it would be interesting to make simulated data for a region in which hypothetical spatial patterns of increased health risk are applied to a population and then make measures of “health risk” based on small areas following traditional approaches. I suspect that a series of realistic simulations would show many cases where measures of health risk are substantially less than they ought to be because of the spatial disconnect between the areas for which measurements are made and the areas where the real risk is elevated. There is, of course, some recognition of this problem in the literature, but I do not see much research designed to deal with the problem. For examples of excellent Monte Carlo simulations of disease patterns, I am impressed with the work of Gelman and Price (1999).

The difference can be seen in the otherwise excellent system for analysis of health risk in the UK described by Aylin et al. (1999), which is area based and one of my current research projects—supported by CDC—which is point-based. An interesting discussion of the problem in general is found in Wakefield and Elliott (1999). In our project we are attempting to develop a GIS-based, rural health surveillance system for evaluating environmental health risks in a typical Iowa county. In this and other projects I am engaged in, I am concerned that contemporary standards for geocoding disease incidences in relation to exposures to potential health risks are not adequate to test reasonable hypotheses without incurring high likelihoods of falsely rejecting hypotheses that are true. I am just beginning a three-year project to evaluate standards for geocoding prostate cancer cases and to determine standards for determining whether methods used are adequate for the purposes used.

My broader research interest is in finding methods to identify robust spatial patterns in measures of the cancer burden. I am working with others here at Iowa on developing “A GIS-based workbench to interpret cancer maps”—a project supported by a grant from the National Cancer Institute. As the title implies, the idea is that through Monte Carlo simulations in which individuals or groups of individuals have computed probabilities of having a given level of cancer burden (for example, the probability that a person with colorectal cancer will be at late-stage when their cancer is first diagnosed), we develop expected spatial patterns consistent with the models that produced the probabilities. We then search for patterns in the differences between expected and observed spatial patterns of the disease burden. We argue that policies or intervention strategies to improve health

outcomes and reduce health risks can be geographically tailored to these observed differences. The purpose of the workbench ultimately is to provide a computational system of analysis for people in regions who are designing more effective cancer control and prevention programs to tailor their interventions to spatial characteristics of the disease burden after adjusting for spatial variations in covariates that affect the disease burden. There are many problems to be investigated and solved before this will be a reality. I am working with colleagues in epidemiology and health administration at Iowa who are working on statistical analyses to account for the influence of covariates in contributing to the cancer burden. One aspect of their research in our project is to link individual records of the diagnosis and progression of breast and colorectal cancer with records of treatment from their health insurance records and Medicare records.

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Terre Satterfield is an anthropologist by training whose research concerns sustainable thinking and action as manifest in the context of specific risk and environmental controversies. Her research interests have included an ethnography of the dispute in Oregon over old-growth logging, and several studies of environmental values including those which demonstrate the limitations of conventional 'dollar-centric' studies of values. A related program of research examines the links between the environmental justice and perceived risk literatures; this has included a national US survey of the relationship between environmental risk and social vulnerability, and a study of a rural African American community experiencing sustained contamination attributed to a local chemical plant. In the current period, Dr. Satterfield has recently completed a study of public involvement concerning the decontamination of a Cold War bomb production site. She is also working with colleagues on a study to identify and represent the values and risk perceptions of New Zealand's Aboriginal Maori community in policy debates and decisions concerning genetically modified organisms. Finally, in the health fields, Dr. Satterfield is involved in a cross-national study of the perception of disease and environmental risks in Chile and China. Her research has been funded by the Social Science and Humanities Research Council of Canada, the US National Science Foundation, the Department of Energy, the World Health Organization, and the Getty Conservation Institute. Dr. Satterfield's work has been published in edited collections, such journals as *Society and Natural Resources*, *Ecological Economics*, *Environmental Values*, *Journal of Social Issues*, *Journal of Anthropological Research*, *Human Ecology Review*, and *Risk Analysis*. Her book, *The Anatomy of a Conflict* (2002) was recently published with UBC Press. The book, with colleague Scott Slovic, entitled *What's Nature Worth?* is in press with University of Utah Press' literature and the environment series.

Elisa J. Sobó, Ph.D.

- Research Scientist & Associate Director for Research, Center for Child Health Outcomes, Children's Hospital San Diego
- Associate Clinical Professor, Department of Family and Preventive Medicine & Department of Pediatrics, University of California San Diego School of Medicine.

Abbreviated CV:

I received my Ph.D. in socio-cultural anthropology at UCSD in 1990, after which I completed post-doctoral studies in medical anthropology at Case Western Reserve University. My first faculty job was at New Mexico State University; I moved from there to the University of Durham, in England. In 1996, I took a post in the Cancer Prevention and Control program at UCSD, and in 1999 I moved to Children's Hospital, San Diego, where I currently oversee or collaborate on various quality improvement, evaluation, and research projects. I also oversee the center's major publication projects.

In addition to numerous peer-reviewed articles, I have authored, co-authored, and co-edited eight books, including *The Cultural Context of Health, Illness and Medicine* (1997, with Martha Loustaunau), *Using Methods in the Field* (1998, with Victor de Munck), and *The Endangered Self: Managing the Social Risk of HIV* (2000, with Gill Green). The latter received the 2001 'Medicine and People' award. As I am an applied anthropologist, my work has been disseminated in not only anthropological contexts but also within the health care arena to research, policy, program, and service audiences.

Previous research:

My initial health-related risk research investigated magic/religion and the perceived risks to health of anti-social or culturally inappropriate behavior. This research, carried out in Jamaica, focused mainly on women's reproductive health but also concerned male and female sexual health in general. Back in the USA, I began to focus on HIV/AIDS and I did so from a health education and prevention perspective. I was particularly interested in the cultural basis for people's inability to see themselves as at-risk for HIV infection or as risky to others. My research with disadvantaged women revealed much about the social risks HIV/AIDS and I followed with a project concerning the ways that men and women with HIV/AIDS navigate or deal with these risks.

Present research and interests:

My research now focuses on child health. For various reasons, including the differential epidemiology of childhood disease and disability, rather than to focus on one health issue, most of my work takes a non-categorical perspective.

In regard to risk, I am currently very interested in patients' or the public's mis/trust of health care professionals, the processes by which such trust is built and maintained, or undermined, and how the individual's creation of trust differ in relation to his or her health status and the 'medical necessity' of the care s/he seeks. I am particularly interested in the rhetorical rationalization of biomedical risk. While I am currently examining this in parents/patients, I also would like to examine it amongst practitioners.

Other interests include:

- Patient-parent-practitioner communication

- Children with special health care needs (especially those with cancer, cleft lip, or Down syndrome)
- Tailored environments for optimizing health and well-being
- Patients' and families' experiences of, and functional acculturation to, the world of biomedicine
- Developing rapid qualitative assessment methods for use by and for health care workers

Links to space/location:

I am excited about expanding our understanding of the links between health-related risk perception and space/location in a way that moves beyond simply linking environmental exposure to health risk. For example, I would like to learn more about how people rationalize the risk of living in a 'dangerous' area (of course taking into account the political-economic dynamics entailed). I am even more interested in increasing my understanding about how people create, modify, and deploy meaning regarding the 'risk' or 'danger' of certain places, such as hospital emergency rooms, clinic waiting rooms, parks, and health clubs, and how this varies with health status and other factors. I also am interested in the role of place/location in relation to health-related *social* risk, such as the variable social risk felt by children with cleft lip or cancer, or parents of children with Down syndrome. Finally, I am most interested in broadening my understanding of other possible ways to link risk perception with space/location, especially in relation to child health and child health services.

PROJECT SUMMARY

Understanding migration structure: a unified approach

Human migration patterns are routinely characterized using hydrologic analogies. Researchers commonly refer to migration streams and occasionally take note of currents, backwaters, and even eddies. To carry the analogy further, migration regions are suggestive of watersheds or catchment areas. The appeal of the analogy is the implied rational structure at the aggregate migration system level with guiding dynamics that are scale independent. Indeed, more than a century of migration research has revealed much about both the structures and the fundamental dynamics. Yet empirical analysis of migration systems has been limited by the availability of methodological approaches capable of identifying latent structures while retaining much of the complexity in the data. The fundamental conceptual elements of migration systems, cross-scale interactions and regionalization, are not adequately integrated into statistical models used to study interregional migration. A statistical framework is proposed, based on design matrix methods for generalized linear models, that provides a common mathematical basis for modeling migration, defining and evaluating migration regions, and visualizing migration regions and flows.

The research will have several broad impacts. At a basic level, an efficient means of identifying migration structure will increase understanding of interregional connectivity and the evolution of human settlement systems. As such, the research potentially informs basic policy issues related to environmental degradation, rural depopulation, suburbanization-exurbanization trends, urban poverty, health, and disease. At a more immediate level the research will inform process models of migration, model-based estimation, and population projections. The research plan includes several activities related to outreach and education.

The key element of the research is the recognition that migration subsystems and typologies, common constructs in migration regionalization, can be represented by GLMs using design matrix modifications and parameter restrictions. That recognition allows for parsimonious model specifications that capture the essential structural regularities in complex interregional flows. This in turn allows for greater disaggregation, more rationally structured migration regions, and computationally feasible model estimation. In effect, the framework imparts geography into essentially non-spatial categorical models.

Cynthia Warrick

Statement of Research Interests

CSISS specialist meeting on Health Risk Perception & Spatial Analysis

My research focuses on the social and environmental determinants of health disparities. I moved into this area following 7 years of working with minority communities on environmental justice (EJ) issues. All of these EJ communities (Augusta, GA; Fayetteville, NC; Washington, DC; Memphis, TN; Geissmer, LA; Houston, TX) perceive that their health problems, primarily cancers, are due to their proximity and exposure to hazardous sites, facilities, and pollution in their neighborhoods. The spatial representation of potential sources of pollution enabled better communication between researchers and community members, and a better understanding of the issues confronting the community. My research uses scientific evidence to support political strategies to achieve environmental justice success.

Current projects in progress and under development:

Environmental Justice in Acres Homes: Booker Landfill – Acres Homes is a historic African American community located in north Houston. Residents of West Donovan Street noticed that a number of their neighbors, on the east side of their street, were getting cancers and other unusual health problems. The backyards of the east side residents are adjacent to the Booker Landfill, a closed un-permitted solid waste landfill. The residents perceive that the health problems of their community are related to exposure from the water that constantly drains from the landfill into their backyards and street. I am directing a participatory action research project to address the concerns of this community. We have been funded by an EPA Environmental Justice small grant to conduct a community health survey and a preliminary environmental assessment of the impacted neighborhood. Toxic levels of metals were found in the soil and water in the backyards and data from the health survey are currently being evaluated. We are working with Congresswoman Sheila Jackson Lee's office to get EPA involvement on the site, and the EPA regional office will be conducting a site visit later this month. The goal of this project is to get an EPA Brownfields Assessment Pilot grant that will enable the community to cleanup and redevelop the Booker Landfill and other potentially hazardous sites in the Acres Homes community. Through this community-based research partnership, other projects that study the relationship between neighborhood effects and cancer prevention will be developed.

Using GIS to Study Mammography Disparities – The primary goal of this study is to determine why some African American women get mammograms and others do not. This project will study how neighborhood effects may or may not contribute to cancer prevention behaviors in communities that get mammograms and in communities that do not participate in breast cancer screening in a 16 county public health region in Texas. Because factors at the public policy level, the community level, the organizational level, and in the practice setting, interact in a synergistic manner to affect provider delivery and patient utilization of healthcare services¹, geographic information systems (GIS) can be used to assess and evaluate the factors related to mammography and breast cancer disparities at multiple levels of analysis for the development of effective intervention strategies. This analysis will use Medicare mammography claims data, stage of breast cancer diagnosis, mortality, mammography facility, and Census data to predict mammography utilization in African American Medicare beneficiaries.

Reinventing Public Health: Toward a Healthy (Re)Public – A “healthy republic” is one in which public decision making takes into account the impacts of policies related to fundamental determinants on the health of the populations targeted by these policies. This is a book project of the Rural Economic and Community Health (REACH) partnership, a policy-oriented, community service, research and teaching group of faculty who meet regularly to develop ideas and programs toward enhancing and evaluating the impact of rural development and community health policy on the health of individuals and communities. The project is led by Dr. Lu Ann Aday and I am the lead author on the chapter on *Community Development & Public Health*. This chapter will lead the reader through the literature to present an understanding of community development and its associated themes, social capital, community capacity, and community organizing and building. Because trust and communication have been identified as major factors for community development success, we will construct a conceptual framework that uses theory developed by Habermas and Paulo Freire, to express the importance of discourse and democratic participation by all affected parties. We will provide an overview and critical evaluation of the major policies that impact community development to expose its strengths and limitations based on their effectiveness, efficiency, and equity, and make recommendations on how to develop policies that influence community development.