Behavioral and Social Sciences as Key Components in National Research Initiatives

Merrill Series on
The Research Mission of Public Universities

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Introduction

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The Fred and Virginia Merrill Distinguished Professor of Advanced Studies and Director, Merrill Advanced Studies Center, The University of Kansas

The following papers each address an aspect of the subject of the fifteenth annual research policy retreat hosted by the Merrill Center: *Behavioral and Social Sciences as Key Components in National Research Initiatives.* We are pleased to continue this program that brings together University administrators and researcher-scientists for informal discussions that lead to the identification of pressing issues, understanding of different perspectives, and the creation of plans of action to enhance research productivity within our institutions. This year, the focus was on how the Behavioral and Social Sciences can play a key role in national research initiatives.

Our keynote speaker for the event, Dr Robert M. Kaplan, outlined the OBSSR's mission to coordinate Behavioral and Social Science research across the NIH institutes and centers, and discussed its efforts to explore the future of this crucial area of research at the NIH.

Benefactors Virginia and Fred Merrill make possible this series of retreats: The Research Mission of Public Universities. On behalf of the many participants over more than a decade, I express deep gratitude to the Merrills for their enlightened support. On behalf of the Merrill Advanced Studies Center, I extend my appreciation for the contribution of effort and time of the participants and in particular to the authors of this collection of papers who found time in their busy schedules for the preparation of the materials that follow.

Eighteen senior administrators and faculty from five institutions in Kansas, Missouri, Iowa and Nebraska attended the 2011 retreat. Though not all discussants' remarks are individually documented, their participation was an essential ingredient in the general discussions that ensued and the preparation of the final papers. The list of all conference attendees is at the end of the publication.

The inaugural event in this series of conferences, in 1997, focused on pressures that hinder the research mission of higher education. In 1998, we turned our attention to competing for new resources and to ways to enhance individual and collective productivity. In 1999, we examined in more depth cross-university alliances. The focus of the 2000 retreat was on making research a part of the public agenda and championing the cause of research as a valuable state resource. In 2001, the topic was evaluating research productivity, with a focus on the very important National Research Council (NRC) study from 1995. In the wake of 9/11, the topic for 2002 was "Science at a Time of National Emergency"; participants discussed scientists coming to the aid of the country, such as in joint research on preventing and miti-

gating bioterrorism, while also recognizing the difficulties our universities face because of increased security measures. In 2003 we focused on graduate education and two keynote speakers addressed key issues about retention of students in the doctoral track, efficiency in time to degree, and making the rules of the game transparent. In 2004 we looked at the leadership challenge of a comprehensive public university to accommodate the fluid nature of scientific initiatives to the world of long-term planning for the teaching and service missions of the universities. In 2005 we discussed the interface of science and public policy with an eye toward how to move forward in a way that honors both public trust and scientific integrity. Our retreat in 2006 considered the privatization of public universities and the corresponding shift in research funding and infrastructure. The 2007 retreat focused on the changing climate of research funding, the development of University research resources, and how to calibrate those resources with likely sources of funding, while the 2008 retreat dealt with the many benefits and specific issues of international research collaboration. The 2009 retreat highlighted regional research collaborations, with discussion of the many advantages and concerns associated with regional alliances. The 2010 retreat focused on the challenges regional Universities face in the effort to sustain and enhance their research missions.

Once again, the texts of this year's Merrill white paper reveal various perspectives on only one of the many complex issues faced by research administrators and scientists every day. It is with pleasure that I encourage you to read the papers from the 2011 Merrill policy retreat on *Behavioral and Social Sciences as Key Components in National Research Initiatives.*

Executive summary

New Directions for the National Institutes of Health (NIH) Office of Behavioral and Social Sciences Research (OBSSR)

Robert M. Kaplan, Associate Director for the Behavioral and Social Sciences; Director, Office of Behavioral and Socials Sciences, NIH

The mission of the Office of Behavioral and Social Sciences Research (OBSSR) is to coordinate and stimulate behavioral and social science research across all NIH institutes and centers. Since OBSSR does not fund research directly, collaboration with the ICs is crucial. How much behavioral and social science research actually takes place at NIH? A reasonable estimate might be around 11-12 percent.

We have to think ahead, and try to imagine where the research will be in 15 or 20 years. OBSSR is trying to think ahead in a number of ways, considering the implications for new research designs, new methods of data fusion and synthesis, new generations of health data analysts, and new approaches to handling the privacy of health-related information and health data security.

To support dissemination and translation research, OBSSR is sponsoring conferences, training institutes, and trans-NIH Funding Opportunity Announcements (FOAs) that highlight different aspects of dissemination, translation, and implementation.

OBSSR is working with the National Academy of Sciences and Institute of Medicine to explore international health differences in high-income countries and identify public health opportunities. Behavioral and social science research clearly has a significant role to play in reducing the global burden of disease.

While OBSSR has been active in each of these areas and will continue to be, we also want to think about what the world — and science — will look like in the next decade or two, and how they can best prepare for it. Discussions with leaders of academic research institutions and with faculty research innovators will help guide future NIH policy and research agendas.

Managing Multi-Institutional Projects

Virginia Moxley, Dean and Professor, College of Human Ecology, Kansas State University

Current scholarly and fiscal environments can make multi-institutional projects preferable to single institution undertakings. Some elements of multi-institutional alliances are common to all alliances. There are competing interests that must be managed. Each partner institution seeks to maximize institutional advantage while also contributing to the common good of the alliance.

Alliances are composed of a complex web of relationships. The chemistry of these relationships is essential to their long-term viability. Because alliances are essentially a web of re-

lationships without much in the way of hierarchy, the maintenance of trust in leaders is an essential component in alliance viability over time.

The organizer of multi-institutional proposals needs to implement a communications plan that assures transparency so each partner understands the basis for the distribution of funds and assignments. Once a multi-institutional project is funded or simply undertaken, the leadership issues change from managing the transition from idea to proposal to managing the realities of working together.

When conflicts are discussed openly by individuals empowered by their employing institutions to resolve such issues, they often lead to innovative and eminently workable solutions. Alliances need to attain fiscal sustainability to endure over time. This requires the decision of one of the institutional partners to serve as fiscal agent to hold funds. Big bureaucracies at the center of the alliance can doom it to financial failure, as can large investments in low value outcomes.

For academic partnerships these tools are needed: a secure student data management system, a student learning outcomes system, a communications system, electronic access for partners and students, and written principles, policies, and procedures. Research alliances will also require tools to make working with colleagues at partner institutions as seamless as possible.

The best alliance experiences come with serendipities. These include an expanded network of valued professional colleagues and advisors, immersion in multiple higher education cultures, rapid dissemination of technical skills because these teams work virtually most of the time, and the ability to easily capitalize on the wisdom of colleagues with similar interests.

Human Dimensions: Integrating the Social and Behavioral Sciences with the Biophysical and Natural Sciences

Prem Paul, Vice Chancellor for Research and Economic Development
Monica M. Norby, Assistant Vice Chancellor for Research
University of Nebraska-Lincoln

As the needs and challenges of our societies become increasingly complex and interrelated, so has the research required to generate solutions to these challenges. NSF's Integrated Graduate Education Research and Training (IGERT) program, competitions such as Science and Technology Centers and Engineering Research Centers, and other programs throughout NSF increasingly have emphasized interdisciplinary teams.

In the 21st century, the growing specter of climate change and other environmental threats brought a new kind of interdisciplinarity to research: the human dimensions. The human dimensions of global climate change – how human social systems affect and react to change in natural systems – became a critical focus of climate change research.

The need to address the human dimensions of science became clear at the University of Nebraska-Lincoln through two major research initiatives over the last five years. We devel-

oped a significant partnership with the U.S. Geological Survey to address climate change in the Greater Platte River Basin. The impact of climate change on agriculture and the water supply was a key focus of the research framework developed through the initiative.

In 2008 the University of Nebraska launched the Water for Food initiative, with the goal of forming a research, education and policy analysis institute with a global reach that would address the critical challenge of growing more food using less water. Nowhere are the human dimensions of research more important than in the issues of food and water security, which go directly to the sustainability of life on the planet.

Research in the social and behavioral sciences is critically important in meeting major challenges facing our society in education, national security, human health and well-being, food and water security, climate change and other areas. Despite the need for this research, funding from the federal agencies for these disciplines has lagged far behind that available for engineering and the physical and biomedical sciences. The National Science Foundation (NSF) and National Institutes of Health (NIH) are two examples of funding agencies where the social and behavioral are being emphasized more and more.

Our experience in fostering interdisciplinary collaboration amongst social sciences, physical sciences, and life sciences research has met with some success. Demand for scholars in social and behavioral sciences is only going to increase as global society faces challenges in dealing with health, food security, national security, climate change and national competitiveness.

Functional Neuroimaging Studies of Obesity: Linking Neuroscience to Health Behavior

Cary R. Savage, Director, Center for Health Behavior Neuroscience; John H. Wineinger Professor of Psychiatry and Behavioral Science, University of Kansas Medical Center

Obesity rates are on the rise and associated with serious public health consequences and rising health care costs. Since 1990, however, rates of obesity have increased dramatically, to the point that over 30% of the U.S. adult population is now obese. In fact, if rates continue unabated, approximately 75% of the adult American population will be overweight or obese by the year 2020. Obesity also has dramatic impacts on increasing health care costs. Recent estimates of the total costs of obesity in the U.S. are over 140 billion dollars per year.

We live in a society where food is plentiful and exercise is optional. Until very recently in our evolutionary history, acquisition of calories for consumption required work. This is no longer the case. We can drive up to a window, and for a few dollars, have literally thousands of calories handed to us from a window. Food portion sizes have also increased.

Given these changes in lifestyle and magnified across a population, we end up with a societal obesity epidemic. The solution is easy – eat less and exercise more. Biology plays a critical role in determining poor health choices at the individual level. Research is now aimed at understanding the biological roots of this resistance to healthy decision-making.

The availability of plentiful, calorie dense, food is a recent development in modern society. We remain biologically driven to consume calories whenever possible and move as little as needed to conserve energy. These drives are largely regulated by the brain.

Motivation and reward processing are especially important contributors to overeating and sedentary lifestyle in humans. Our initial functional imaging studies have identified brain regions that respond differently to visual food cues in obese and healthy weight individuals, and are positively correlated with reports of hunger in obese participants.

Our preliminary data indicate that unsuccessful dieting is predicted by decreased activity in parts of the brain implicated in behavioral inhibition and control (prefrontal cortex) and increased activity in the areas of the brain controlling the mouth and tongue. These results provide important clues about resistance to weight loss in diets. We are now analyzing the longitudinal data from the study in order to identify predictors of 6-month weight loss maintenance.

Healthy behaviors are in part difficult to maintain because they are less immediately gratifying. In fact, exercise may initially be perceived as aversive. Despite this challenge, some people are able to persevere and experience long-term benefits. We hypothesize that brain processes underlying reward processing and impulse control will help us better understand mechanisms of obesity and health-related decision making.

The Center for Health Behavior Neuroscience was formed at the University of Kansas Medical Center (KUMC) in 2010 to support and unify research efforts at KUMC that are focused on brain function contributions to obesity, addiction, and other health behaviors.

Dilemmas and Opportunities Surrounding Participatory Research to Promote Health in Small Towns

Elaine Johannes, Associate Professor and Extension Specialist, School of Family Studies and Human Services, Kansas State University

The Kansas population is surging in urban areas while declining in small towns and rural areas. De-population of rural areas and small towns due to lack of well-paying jobs, viable schools and inspirational leadership is an issue. Working through volunteer networks comprised of youth and adults around issues of health for all residents, Kansas State Research and Extension's ***Get It – Do It!*** program has helped small towns move toward sustained quality of life and thriving.

Targeted programs that increase the social, built and human capitals of communities can result in health and quality of life improvements. But unfortunately, many small towns in the United States lack the resources to adapt health promotion strategies to their unique cultural features. Successful and sustainable efforts to improve the health of small town citizens require a community development – participatory approach which is distinct from the traditional expert service delivery model.

Kansas State Research and Extension developed the *Get It – Do It!* program in 2007, using a community-based participatory approach. The goals of *Get It – Do It!* are to foster youth-

adult partnerships, engage youth in meaningful roles, enhance social capital, support the local development vision, and increase health-promoting opportunities (e.g. park improvements, summer camps, trail development, out-of-school health programs)

Get It – Do It! accomplishes these goals through networks of youth-adult partnerships in small towns that receive financial resources, training and support from local intermediaries to increase opportunities for physical activity, improve built environments and strengthen community social capital. Of special focus is increasing the engagement of young people - thereby increasing their community attachment through community-based participation.

Since 2010, *Get It – Do It!* communities reached over 1,500 rural individuals and generated nearly $75,000 in-kind through volunteer involvement. Local projects have also improved places such as town squares, parks, walking trails, skate parks and have used those places to launch health promotion campaigns and activities. Most importantly, the small towns have discovered that promoting health is a viable way to engage young people and to build leadership skills and community attachment among youth.

Behavioral Sciences and Drug Discovery

Sam Enna, Professor of Physiology and Pharmacology; Associate Dean for Research and Graduate Education, University of Kansas Medical Center

Defining the behavioral effects of chemical substances remains an important component in the modern era of drug discovery. Agents are sought that provoke desirable, or diminish undesirable, behaviors. Behavioral tests are employed to determine whether a drug candidate unintentionally modifies central nervous system function, with such an action often being considered a side effect or toxicity.

Given the ongoing need to define the behavioral consequences of potential pharmaceuticals and environmental agents, there is a critical need for research and training in the behavioral sciences. Unfortunately, support for such programs has waned. This reflects a general shift away from *in vivo* animal experimentation to *in vitro* assays for identifying and characterizing drug candidates.

As a result of this shift in research emphasis, the number of scientists trained in organ system and behavioral pharmacology has declined. This was driven primarily by stagnation in federal funding for research involving vertebrate animals. The shift away from *in vivo* assays has had practical consequences – it ultimately led to a shortage of scientists capable of conducting well-designed, and appropriately interpreted, *in vivo* laboratory animal studies in general, and behavioral experiments in particular.

Within the past decade the emphasis on first characterizing molecular mechanisms in the search for new drugs had led to erosion in the expertise ultimately needed to develop chemical leads into viable drug candidates. Among the disciplines that were becoming underrepresented in this regard were the behavioral sciences, and both basic and clinical pharmacology.

More recently, it is acknowledged that efforts must be made to re-establish the importance of *in vivo* testing, behavioral observations and analysis in the drug discovery process. Because the expertise necessary for designing such tests is diminishing, funding agencies in the United States, United Kingdom, and Europe are underwriting training programs aimed at exposing biomedical scientists to the fundamentals of whole animal research.

As the response to systemically active drugs and other xenobiotics typically involves the interplay of several organs and organs systems, the ability to understand such interactions, and to examine such effects experimentally, is an essential component of the drug discovery process. The renewed appreciation of the importance of whole animal and organ system research, and the appropriation of funds to reinvigorate training in these areas will help redress the imbalance in preclinical research emphasis in the search for new drugs.

The evidence suggests that efficient and productive biomedical research programs should include equal measures of studies involving whole animals and organ systems and those aimed at characterizing the biochemical and molecular targets of the drug candidates.

Developing a Top 25 Program in the Behavioral and Social Sciences

David Geary, Curator's Professor; Thomas Jefferson Professor, Dept. of Psychological Sciences, University of Missouri

In 2002, the contributions of the Department of Psychological Sciences to the University of Missouri were evaluated. Our goal was to determine changes that needed to be made to become a nationally recognized top 25 department.

Two policies allowed us to work toward self-enhancement without the need for additional general operating funds. The first was the College of Arts and Science policy of allowing departments to keep general operating salary funds that are covered with federal or other grants; and the second is the Office of Research policy to return 25% of facilities and administration funds to departments.

When I became chair, our course load was four courses per academic year. I determined that for top public research universities, the teaching load for psychology faculty members was three courses per year, with a grant release option of two courses. We determined that our departmental policy of four courses each academic year placed us at a disadvantage relative to these departments.

During the same five-year span (1997-2001), an increase in grant-related activities created additional demands on the associated support staff. The department's external funding has reached a level that would have been difficult to maintain much less increase without additional support staff. To address these issues the department proposed the institution of a "Research Intensive Track" for faculty who meet expectations for research contributions, and added a grant-writer to the staff.

The 2010 NRC ranking provided an opportunity to assess our progress toward achieving our top 25 goal. Using the lower value of the ranges, the Department of Psychological Sciences was ranked 41 on reputation and 29 in faculty productivity. As a comparison, the Psy-

chology Department at the University of Texas-Austin (highest in Big 12) was 26 on reputation and 27 in faculty productivity. We seem to have gained some ground.

In summary, there are university policies that can increase incentives for faculty members to seek external funding and incentives for departments to change their workload and governing policies to further support these activities. Developing and maintaining strong departments in the social and behavioral sciences requires some creativity and risk taking.

The Nexus of Scientific Integration with Behavioral and Social Sciences

Sharron Quisenberry, Vice President for Research and Economic Development, Iowa State University

In a recent strategic planning process, Iowa State University developed and implemented a research enterprise plan that balances the multiple goals of the institution while taking into consideration public and private interests. Research focus areas identified are as follows: Integration of behavioral and social sciences; integrated, innovative health; biorenewables; new technologies; environment.

Faculty are encouraged and rewarded for working across disciplinary lines. The solution of complex problems needs a diversified approach or contributions from multiple disciplines and thus, must be promoted from a transdisciplinary scholarship perspective. This approach will also allow us to study the past, to imagine the future, and to synthesize the constantly changing technology, viewpoints, and culture through creative inquiry – the behavioral and social sciences.

By daring to be different and using a transformational systems approach for the research enterprise, we are able to prioritize and integrate our research activities and thus, better able to set achievable and targeted goals and metrics that meet societal challenges and public/private interests.

Working at the intersection of biology, engineering, physical sciences, and behavioral and social sciences, the university has a basic foundation of talented faculty and research accomplishments to build successful food security, nutrition, and infectious disease portfolios at the interface between plant, animal, human, and environmental health.

Iowa State University has significant transdisciplinary research strengths that can be integrated to create a unifying and systems-wide vision for resolving society-related challenges such as health, energy, food, and environment. This vision will be achieved by creating a seamless research program that spans basic, applied, and translational research and exploiting synergies among the life sciences, the physical sciences, engineering, and the social and behavioral sciences to create platform technologies and solutions for the significant challenges facing society.

Advancement of the Social Sciences through Interdisciplinary Collaborations

Robert Duncan, Vice Chancellor for Research, University of Missouri

Rapid advances in virtually all other disciplines today are being propelled by interdisciplinary collaborations. I will give some specific examples of successful collaborations in this category at MU, including:

Understanding perfect autobiographical memory: A collaboration between psychologists, neurologists, and brain imaging scientists. About 20 people have been identified with perfect autobiographical memory. An understanding of the underlying reasons for this exceptional ability may prove useful, even revolutionary, in the study of how brain structure and dynamics influences human capability, and in how emotional stability is influenced, if at all, by the ability of people to forget prior experiences.

Nuclear activation analysis and the MU Archaeometry Program: A collaboration between archeologists, anthropologists, and nuclear scientists and engineers. The MU Research Reactor Archaeometry Program analyzes many different artifacts from ancient indigenous populations. This powerful new technique can provide a valuable new source of data to test earlier thoughts, hypotheses, and assumptions regarding the movements of ancient populations, such as those for which there is only a limited record of their society and traditions.

Applications of Complexity Theory to the Social Sciences, especially in the systematic development of 'Econophysics'. The application of scaling and self-organized criticality (SOC) to the social sciences appears to be a rich area for interdisciplinary collaborations. The systematic development of complexity theory has been remarkably systematic, and its applications to the social sciences are profoundly enabling of our abilities to understand much more deeply the true nature of risk and benefit in these systems.

The advancement of all of our disciplines will depend largely on the expansion of resources available for our professional pursuits, and this in turn will require society to see and understand an expanding relevance of our work to the betterment of humanity. In my experience, fresh approaches that become ever more demanding on data-based inferences, and on the systematic development of knowledge through the Scientific Method, most rapidly prove this worth to society, and hence win their support.

Such opportunities are also thrilling intellectually, since they almost always lead to unexpected discovery, and the elucidation of systems and processes that were at best poorly understood before. It is this spirit of discovery, coupled with the broader relevance of our work in the social sciences, which promises to reverse the current negative opinion trends, and provide a healthy advancement of these social science disciplines for many decades to some.

Building Collaborative Research Teams in the Social and Behavioral Sciences

Chitra Rajan, Associate Vice President for Research, Iowa State University

For the past few years, Iowa State University (ISU) has experienced severe and permanent reductions in state support. We considered and adopted a number of structural changes aimed at reducing costs. At the same time, this was a period when many of the prior investments in faculty recruitments and research infrastructures were beginning to pay off: after three years of declines in sponsored funding, the university saw not only an up-turn, but significant growth in research expenditures.

The university had adopted a decentralized budget plan whereby colleges and vice presidents received a share of the F&A revenues and were responsible for overhead costs. We also made the difficult decision to discontinue support for several centers and institutes so that we could re-organize and truly support a smaller number of programs.

The faculty members were able to garner enough grants to cover their direct expenses; it was the overhead costs that had become prohibitive. To address this problem, we had to find a way to reduce the overhead costs. We decided to consolidate the "service" components from both centers to create a new unit – the *Survey and Behavioral Research Services center* (SBRS).

The SRBSs' primary mission was to serve as many faculty as possible, and once established, it would operate as a fee-for-service unit. If successful, it would attract enough 'business', become self-reliant (or at least, require minimal institutional funds) and therefore unaffected by fluctuations in state support for the university. It has the capacity to provide a full set of services to researchers including both proposal development and administration and all modes of data collection services.

The SBRS is now a year old and its first year proved to exceed all our expectations. The unit helped faculty submit over 30 grant proposals worth about $16 million. SBRS has 3 years to prove its viability and the associated faculty have been told that they will be assessed based on the following: (a) it has enabled research that was otherwise not possible (and not just diverted research management from other units); (b) impacted a broad group of faculty; and (c) is able to develop a "business model" that makes it fairly independent of institutional support.

One Approach to Establishing a Research Center in Today's University Environment

Dennis Molfese, Mildred Francis Thompson Professor; Director, Center for Brain, Biology, and Behavior, University of Nebraska-Lincoln

In the fall of 2010, the University of Nebraska-Lincoln recruited a senior investigator to build an interdisciplinary brain-imaging center. This recruitment developed from a faculty initiative, Systems Biology of Social Behavior (SB^2), which was supported by several departments within the College of Arts and Sciences.

Faculty from behaviorally-oriented departments requested access to brain imaging equipment to address questions related to their own fields of study. One year later, an officially des-

ignated "Center for Brain, Biology and Behavior," exists that houses two different functioning brain imaging systems (high-density EEG, NIR) with a third type (fMRI) on order.

Faculty support is essential to the success of any large-scale initiative within the University. Faculty and their students must support the initiative, and Center objectives must also be congruent with faculty interests and goals. In our case, the faculty and Administration had already begun to develop a shared vision as part of the SB^2 initiative.

For a Center to be successfully established and thrive, there must be sufficient faculty interest, the means to grow additional involvement from other faculty and students, Administrative support, common activities to facilitate professional interactions, a training program in the use of Center equipment and facilities, a scheduling program to maximize the effective use of core facilities, the means to foster grant development projects to federal and private agencies, and a strong external panel of expert advisors willing to lend their expertise to support the Center's success.

Some institutions such as the University of Missouri-Columbia maintain an imaging center within a specific department. Other institutions have established stand-alone Centers overseen directly by an administrative level or maintained as part of a medical school as is the case at Yale University. In our case, an administrative decision was made to have the Center Director report directly to the Vice Chancellor for Research and Economic Development.

In the 10 months since the Director was hired, 134 faculty and students have attended training workshops. Three faculty have already been sponsored for NIH K award submissions and six students have submitted NSF predoctoral training applications and NIH NRSA training applications. A competitive State of Nebraska Research Initiative grant for $1.2 million was awarded that augmented funds for purchasing imaging and computing equipment for the Center. In the meantime, plans are finalized for installing the 3T fMRI in temporary housing so that research using the magnet can begin in January.

This fall and winter will be a critical time for the Center. The hope is that spring will see manuscripts being submitted from faculty and students citing a literature and using neuroimaging techniques that were unknown to them a year ago. Our goal is that these manuscripts will break new and fertile ground. The success of the faculty, students and Center are intertwined. All the tools needed for success are here. The most important of these of course is the talent, enthusiasm and energy possessed by the faculty and students to conduct cutting-edge science!

Evolutionary Neglect of Aging: An Opportunity for the Behavioral and Social Sciences

David Ekerdt, Director, Gerontology Center; Professor of Sociology, University of Kansas

The late Paul Baltes, a psychologist at the Max Planck Institute in Berlin, was the leader of a sprawling international network of scientists concerned with human development across the life span. Baltes outlined the basic biological and cultural architecture of human development (Baltes, 1997). He argued that this architecture is progressively less complete

across adulthood and into later life. This contention about incompleteness is what I will review here.

Three principles support the proposition about incompleteness. As the first principle, Baltes observed that the benefits resulting from evolutionary selection diminish with advancing age. The main takeaway is this: that as life goes along, there is less fitness from our biological design.

Baltes's second principle is that there is an age-related increase in the need or demand for culture. "Culture" here is shorthand for all sorts of knowledge-based resources: psychological, economic, material, technical, symbolic. It encompasses advantages from public health, educational strategies, literacy, human rights, medical care—all the fruits of human ingenuity.

With advancing age, evolutionary benefits weaken, but culture compensates. However, according to Baltes's third principle, there "is an age-related loss in the effectiveness or efficiency of cultural factors and resources". The goods and affordances that were

Longer life expectancies (the biblical four-score years) allow adults the imagination of things that *could yet* happen or *could yet* be tried. This is the great shining promise of retirement, for which people start saving decades in advance.

At the same time, in later life people begin to sense their finitude. Intimations of mortality can promote additional personal development even as the life-world narrows. However, another outcome can be a sense of despair and frustration about what is no longer possible. In either direction, the resolution of this problem of meaning will have consequences for those to whom our lives are linked.

In the case of human development across adulthood, the research program for the social and behavioral sciences requires great skill in the characterization and interpretation of within-individual change. The theory-driven, action program is this: (1) Appreciate (but do not exaggerate) the contours of declining bodily fitness. (2) Analyze how cultural habits, social structures, human ingenuity, and a will to survive extend life and promote welfare. (3) Devise ways by which this support can be optimized, to the end.

This year, 75 million Baby Boomers—nearly one-quarter of the American population—begin to turn 65. For the behavioral and social sciences, there is plenty to do.

New Directions for the National Institutes of Health (NIH) Office of Behavioral and Social Sciences Research (OBSSR)

Robert M. Kaplan, Associate Director for the Behavioral and Social Sciences; Director, Office of Behavioral and Social Sciences, NIH

The National Institutes of Health (NIH) is a complex organization with 27 Institutes and Centers (ICs). As one of four programmatic offices within the NIH Office of the Director, the mission of the Office of Behavioral and Social Sciences Research (OBSSR) is to coordinate and stimulate behavioral and social science research across all NIH institutes and centers. Since OBSSR does not fund research directly, collaboration with the ICs is crucial. Although OBSSR is not in a position to control what individual IC directors may choose to fund or focus upon, behavioral and social science activity is common across the ICs, - both in terms of basic research on behavioral and social mechanisms affecting health, and translational research on converting knowledge into practice.

In addition to OBSSR's coordinating role, members of an NIH-wide behavioral and social science research coordinating committee meet monthly to keep one another informed and to streamline and leverage their various activities, as needed.

How much behavioral and social science research actually takes place at NIH? OBSSR is exploring this question more systematically and in some detail, but until that analysis is completed, a reasonable estimate might be around 11-12 percent of the total NIH budget. Although all the ICs report at least some behavioral and social science activity, the National Institute on Mental Health (NIMH) is the biggest player, followed by the National Institute of Drug Abuse (NIDA), the National Institute on Child Health and Development (NICHD), the National Institute on Aging (NIA), NIAAA, and the National Cancer Institute (NCI) (See Figure 1).

NIH Mission Statement

NIH's mission is to seek fundamental knowledge about the nature and behavior of living systems and the application of that knowledge to enhance health, lengthen life, and reduce the burdens of illness and disability.

OBSSR's priorities need to be aligned and coordinated with those of NIH overall and the broader notions of health are embedded in NIH's mission statement. In particular, five opportunities for research at NIH that Dr. Collins presented in a Science article (Collins 2010) soon after he assumed the NIH Director role:

- High-throughput technologies;

- Translational medicine;
- Benefitting health care reform;
- Focusing more on global health; and
- Reinvigorating and empowering the biomedical research community.

Some of the work is already underway at OBSSR and elsewhere within NIH. Specific opportunities include:

Back to basics

OBSSR is home to the NIH-wide OppNet program, which represents a significant and ongoing investment in strengthening the relationship between basic biomedical and behavioral/social science research across the agency.

Taking advantage of current and future innovation

While high-throughput technology has not been a major focus of activity (yet), gene-environment interaction (GEI) is — and promises to be even more so in the future. OBSSR is active in the GEI area by linking the exposure biology program (which is developing technologies and biomarkers for tracking diet, physical activity, environmental exposures, psychosocial stress and addictive substances) with research on genetic variants.

Current OBSSR and NCI-funded research being conducted by Kevin Patrick at UC San Diego on the "exposome" — a concept comparable to the human genome, but that measures instead the exposures (including lifestyle factors as well as environmental ones) that a human experiences across the life course and explores the relationships between these exposures and disease (Wild 2005). In many respects, measuring genotypes is fairly straightforward, compared to the dynamic, lifelong exposures that evolve continuously, starting *in utero* and continuing through childhood, adolescence, adulthood and old age. Gene and environmental exposure should be considered together, but currently there's an imbalance in the tools for measurement.

With the widespread adoption of mobile phone technology (currently at 5 billion users worldwide and expected to quadruple to 20 billion within the next decade) and applications for phones and other devices, changes in how health is portrayed, measured, and understood will follow.

Certainly, there is justifiable skepticism that some new apps will merely offer glitzier versions of "old school" (and ineffective) health education messages. Still, the technology is likely to change very rapidly, offering potential uses we can't even envision yet. For example, some basic cell phone apps exist that allow an individual to take an overhead picture of a plate of food at a meal, and estimate the intake of protein, carbohydrates, fat, etc. (Borrell 2011). The technology is crude at the moment, but won't be for long — new iterations are already in development. Similarly, sensors and nanotechnology are already becoming feasible means of capturing and relaying information in real time — such as merging GPS and activity data to determine which park features support the most physical activity.

The point is that we have to think ahead, and try to imagine where the research will be in 15 or 20 years. "Will we have the right technologies?" "Are we thinking far enough ahead?" OBSSR is trying to think ahead in a number of

ways, considering the implications for new research designs, new methods of data fusion and synthesis, new generations of health data analysts, and new approaches to handling the privacy of health-related information and health data security. Specific OBBSR activities and partnerships in these areas include a Systems Science Institute conference held in Pittsburg in May 2011, mHealth with Qualcomm in June 2011, a "Big Data" initiative on data visualization, and exploring ways to harmonize psychosocial information in EMRs.

Informing public policy

Benefitting health care reform was another item on Dr. Collins's "opportunities" list; he would like to see NIH more involved in presenting evidence-based opinion that could provide insights for public policy. This represents a new direction for NIH, which typically has shied away from public policy research. For OBSSR, which is a natural home for these activities, it has meant participating actively in a CMS working group and becoming more involved in partnerships with the Centers for Disease Control and Prevention (CDC).

One area of interest is the negative relationship between the quality of health care and Medicare spending. Iowa, for example, is on the low end of expenditures but the high end of quality, while California spends nearly the most yet achieves the very low quality in relation to other states. As an example, consider my two former hometowns in southern California, just 100 miles apart: Los Angeles and San Diego. The Medicare program spends an average of $11,300 for each recipient in Los Angeles, in comparison to $8,500 in San Diego (Kaplan 2011). To illustrate how the importance $2,800 difference in expenditures could be in two communities sharing such geographic proximity, consider the cost of a Lexus ES 300 — a luxury car that currently retails for just under $52,000. The car's cost represents the difference in median Medicare costs between Los Angeles and San Diego counties (based on Dartmouth Atlas data) for a 65-year-old with a projected 18.6-year life expectancy from that point forward ($2800 x 18.6 years = $52,080). Simple calculations suggest that you could afford to buy a brand-new Lexus for every Medicare recipient in Los Angeles (1.3 million people) if they would accept the medical care one gets in San Diego instead. Getting more for less, and getting higher health care quality at lower costs, are questions to pursue and document.

Answering the dissemination challenge

Although we spend billions to create the next generation of therapies and cures, we spend a very small proportion of that investment — as little as $.01 for every $1 — on learning how to disseminate those same treatments (Woolf and Johnson 2005). For example, treatment of high blood pressure to control hypertension is an area we can take pride in.

According to NHANES data from 2004, awareness of hypertension among those with high blood pressure reached 80 percent (Egan, Zhao et al. 2010). But only 70 percent of these patients were in treatment, and only 30 percent had their blood pressure under control. The latest data show some improvement, with control as high as 50 percent. However, even in this scenario, if 80 percent are aware, 70 percent are under treatment,

and 50 percent of patients have their high blood pressure under control, this "improved" level of control still means that only 28 percent of those with high blood pressure are successfully treated. We know from clinical studies that almost anyone can have his or her blood pressure controlled: It's a problem of dissemination.

Comparisons of investments in tweaking molecules versus dissemination show a far greater return on investment for investments in dissemination. For example, office reminders for cholesterol treatments were estimated to prevent seven times more deaths than replacing older cholesterol-lowering drugs with more potent versions of the drugs (Woolf and Johnson 2005).

To support dissemination and translation research, OBSSR is sponsoring conferences, training institutes, and trans-NIH Funding Opportunity Announcements (FOAs) that highlight different aspects of dissemination, translation, and implementation.

Going global

Global health issues are another opportunity on Dr. Collins's list. Although life expectancy for females has increased steadily in developing countries since 1960, life expectancy increases for women in the United States are not keeping pace with the rest of the world, with the United States now ranked 47th (Crimmins, Preston et al. 2011). OBSSR is working with the National Academy of Sciences and Institute of Medicine on a project to explore international health differences in high-income countries and identify public health opportunities. The Office values global health, recognizing the importance of global health in an increasingly interconnected world. More specifically, behavioral and social science research clearly has a significant role to play in reducing the global burden of disease. OBSSR is active in several workforce and research training initiatives in Africa, most recently convening a week-long institute in South Africa that brought together 45 researchers from 13 sub-Saharan countries.

While OBSSR has been active in each of these areas and will continue to be, we also want to think about what the world — and science — will look like in the next decade or two, and how we can best prepare for it. Discussions with leaders of academic research institutions and with faculty research innovators will help guide future NIH policy and research agendas.

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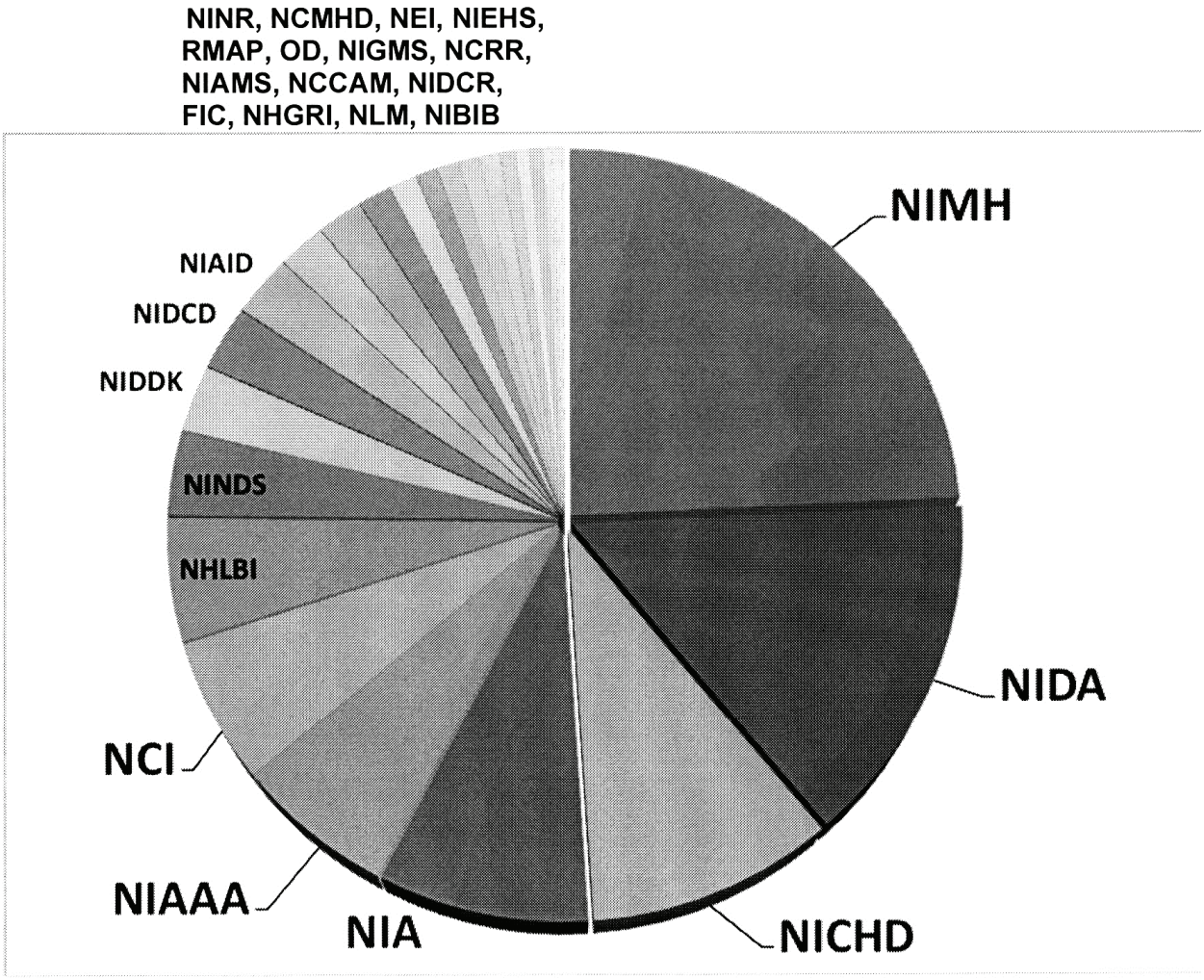

Figure 1. Fiscal Year 2010 NIH Behavioral and Social Science Research Funding by Institute of Center. Total non-ARRA funding was $3.53 billion

Managing Multi-Institutional Projects

Virginia Moxley, Dean and Professor, College of Human Ecology,
Kansas State University

The realities of current scholarly and fiscal environments sometimes make multi-institutional projects preferable to single institution undertakings. It makes sense, after all, that complicated projects are best tackled by a diverse team of experts who bring the collective resources of their employing institutions to bear on the work of the joint project. I have been engaged in major multi-institutional projects throughout the past decade and have had the opportunity to observe characteristics of successful and of ultimately unsuccessful multi-institutional collaborations.

My specific focus has been the creation and management of online graduate degrees sponsored by an alliance of major research universities. Because the projects have engaged multiple scholars employed in multiple departments at multiple universities as well as students who are admitted to graduate study at those universities, the consequences of failure are quite far reaching. Perhaps that is what propels all of us who participate in this alliance to continue our search for principles, practices, and policies that will sustain and enrich the alliance over time. The alliance that informs much of the information that follows is the Great Plains Interactive Distance Education Alliance (Great Plains IDEA). For specific information about this alliance, go to www.gpidea.org.

Some elements of multi-institutional alliances are common to all alliances. For example, institutions are represented in the alliance by an individual and that person does not oversee all of the university entities from which support is essential if the alliance is to thrive. So, each institution will need an internal team representing the functional areas that are impacted by the alliance. The Great Plains IDEA partner institutions have found it imperative to have internal teams that include the academic deans for the colleges where the degree programs are located, the graduate dean who oversees all graduate program and student issues, the chief financial officer who can collaborate with peers at other partner institutions to reach agreement on a common price per credit hour for all students in alliance sponsored programs at all partner institutions, the participating faculty members and their department heads who manage workload issues, and a continuing education administrator who brings all of the support and regulations of the University for online delivery to the project. As Rosabeth Moss Kanter (1994) noted, the challenge of strategic alliances is that they make sense to the individual that proposes them, but they make work for others—some of whom may be actively opposed to the alliance.

In any multi-institutional project alliance, there are competing interests that must be managed. Each partner

institution seeks to maximize institutional advantage while also contributing to the common good of the alliance because in well executed alliances, institutional interests are best served when the overall alliance flourishes. Faculty participants also have competing interests. They work on the multi-institutional project but are not employed by the alliance. Their annual merit reviews and promotion and tenure success are dependent upon departmental colleagues and administrators, whose support of alliance participation is vital to assuring that benefits rather than costs accrue to faculty as a consequence of alliance work.

Alliances are composed of a complex web of relationships. The chemistry of these relationships, according to Kanter (1994) and confirmed by my experience, is essential to their long-term viability. People with choices will only commit over time to relationships that energize and motivate them in their work—they will withdraw from relationships that deplete their energy or disadvantage them in their work.

Leadership of multi-institutional alliances is broad-based. The one essential attribute of alliance leaders is generosity. Leaders must put the interests of the alliance on a level with institutional interests. Only when there is abundant evidence that the leader behaves generously will others allow the individual to lead. Because alliances are essentially a web of relationships without much in the way of hierarchy, the maintenance of trust in leaders is an essential component in alliance viability over time.

For scholars from multiple universities to propose a joint project or program for extramural funding requires some pre-existing conditions:

- A research administration that supports the financial and reporting complexities of multi-institutional projects.
- Pre-existing relationships with the scholars from the proposed partner institutions. It is next to impossible for a group of strangers from different institutional cultures to develop a winning proposal without time to formulate a compelling common agenda, to agree on individual responsibilities, and to assign costs.
- An organizer who makes it easy for partner institutions to develop their statements of work and their budgets and who identifies and helps to collects other necessary documentation.

In a current multi-institutional project for which I serve as P.I., the timeline from release of the RFP to submission of proposals was quite brief. The proposal's success was furthered by the pre-existing relationships with the subcontract P.I.'s at all ten of the subcontracting institutions. My staff and I prepared individualized statements of work for each of the institutions based on their feedback to a query about portions of the project in which they intended to participate. We also developed and disseminated a

formula for financial support of subcontracts and a budget template with only the bottom line (which was different for each partner institution) and indirect costs (which were at the same percentage at each partner institution) pre-computed. Institutions determined how best to allocate their project funds to accomplish their assignments. We also asked specifically for other documentation such as vitas and letters of support and provided a timeline for submission of materials. The organizer of multi-institutional proposals needs to implement a strategy that makes it easy for the partners to comply quickly and needs to implement a communications plan that assures transparency so each partner understands the basis for the distribution of funds and assignments.

Once a multi-institutional project is funded or simply undertaken, the leadership issues change from managing the transition from idea to proposal to managing the realities of working together. How can working together be hard? Let me tell you the ways.

If the alliance crosses state lines, the leaders confront different laws as well as differences in policies, practices, and institutional cultures. Often, institutional representatives think policies are laws when they are not or that prior practice is based on policy which is sometimes, but not always, the case. We have learned to ask in multi-institutional work, whose policy or law is it? Every rule, be it a law, a policy, a practice, or a tradition comes with an address—to tweak the rule, engage the addressee. Fortunately, institutional attorneys advise on legal issues. One simply needs to ask them to investigate.

There are multiple points of disagreement about multi-institutional projects. These disagreements cannot be avoided. Ignoring conflict does not end it. When conflicts are discussed openly by individuals empowered by their employing institutions to resolve such issues, they often lead to innovative and eminently workable solutions. When they are deferred because they arouse anger or they are resolved by agreeing to a compromise that works for every institution but does not advance the project or when disagreements about administrative issues are taken on by faculty or disagreements about curriculum issues are taken on by administrators, participants become frustrated, work grinds to a stop, and commitment to the alliance is lessened.

Participants come to multi-institutional partnerships with assumptions—most of which they have not questioned before entering into the work of alliance building. Some of these assumptions, i.e., "what is good for my institution is good for others," or "institutional practices of multiple universities are aligned" are faulty. Implicit assumptions are always present. Participants need to examine assumptions and make them explicit through developing principles to guide practice.

Communication within an alliance requires special attention to how each of the participating individuals at each of the partner institutions is best informed and best heard. The process is not unique, but its practice is rarely

optimized. The simple mandates include:

- Conduct regular meetings either in person or via telecommunications. These meetings promote a sense of urgency about the work of the alliance and facilitate engagement by the participants. Distribute written records of the meetings promptly and expect all participants to read the written record and fulfill the assignments they assume.
- Provide information promptly to those requesting it—and, when the inquiry takes on the form of a frequently asked question—provide the reply to all relevant participants.
- Make it easy for partners to do their part. Send frequent reminders about task deadlines and standards.

Alliances need to attain fiscal sustainability to endure over time. This requires the decision of one of the institutional partners to serve as fiscal agent to hold funds. In the case of academic alliances, the institutional CFO's will work to manage both the price to students and the costs to the institutions and to the alliance to assure that income covers costs. The computation of costs for new undertakings within old institutions is as much art as science. Major institutions always have sunk costs that, if assigned to the alliance, can price the program out of the market. Big bureaucracies at the center of the alliance can also doom it to financial failure as can large investments in low value outcomes.

To support the web of relationships in alliances, a managing partner institution is needed. The managing partner is compensated to provide services, to look for the next big thing for the alliance to pursue, to create web interfaces, to plan meetings, maintain a directory of participants, to exchange data securely, to promote adherence to agreements and timelines, and to communicate intrusively to help participants maintain focus on the multi-university project.

For academic partnerships tools such as these are needed: a secure student data management system, a student learning outcomes system, a communications system, electronic access for partners and students, and written principles, policies, and procedures. Research alliances will also require tools to make working with colleagues at partner institutions as seamless as possible.

Build redundancy in the system to accommodate abrupt changes in any partner's circumstances. The employment churn in higher education becomes a special challenge for multi-institutional projects. One project for which I served as P.I. involved a core team of 60 individuals from 10 institutions. Over the course of the three year project, 120 individuals were part of the team due to personnel changes. The downside was the constant need to acculturate newcomers. The upside was the rapid national dissemination of the model we created as former participants moved to new institutions

and took their alliance building experience with them.

The best alliance experiences come with serendipities. These include an expanded network of valued professional colleagues and advisors, immersion in multiple higher education cultures, rapid dissemination of technical skills because these teams work virtually most of the time, and the ability to easily capitalize on the wisdom of colleagues with similar interests.

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Human Dimensions: Integrating the Social and Behavioral Sciences with the Biophysical and Natural Sciences

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As the needs and challenges of our societies become increasingly complex and interrelated, so has the research required to generate solutions to these challenges. The last two decades have seen a growing emphasis on interdisciplinary research as a way of addressing complex problems. Reports such as "Facilitating Interdisciplinary Research," published in 2004 by the National Academies of Sciences and Engineering and Institute of Medicine of the National Academies stimulated discussion and efforts to break down barriers among disciplines. The National Science Foundation led the way in encouraging and even requiring interdisciplinarity in funded programs.

NSF's Integrated Graduate Education Research and Training (IGERT) program, competitions such as Science and Technology Centers and Engineering Research Centers, and other programs throughout NSF increasingly have emphasized interdisciplinary teams. Yet often the resulting "interdisciplinarity" has been collaborations among faculty from closely related fields, such as physicists with chemists or mathematicians with computer scientists.

Human Dimensions

In the 21st century, the growing specter of climate change and other environmental threats brought a new kind of interdisciplinarity to research: the human dimensions. Initially, human dimensions referred to the interrelationships of people and the environment, particularly with respect to environmental change. Human dimensions often concerned broad issues dealing with government policies or institutional responses to change, their impact on society and the response of people affected by change. The human dimensions of global climate change – how human social systems affect and react to change in natural systems – became a critical focus of climate change research. Expertise in the social and behavioral sciences, such as political science, law, economics, sociology and other disciplines was critical to this research.

The need to address the human dimensions of science became clear at the University of Nebraska-Lincoln through two major research initiatives over the last five years. Over several years we developed a significant partnership with the U.S. Geological Survey to address climate change in the Greater Platte River Basin, which stretches from the Rocky Mountains to the Missouri River and encompasses all of Nebraska and parts of Colorado, Wyoming and South Dakota. The impact of climate change on agricul-

ture and the water supply was a key focus of the research framework developed through the initiative, so the impacts on the people of the region were of paramount importance. Thus the research must address the needs of stakeholder groups ranging from farmers, ranchers and urban dwellers to natural resource districts, water managers, NGOs, and policy- and decision-makers at all level of government. Sociologists, economists, psychologists, law and policy experts, and education and extension specialists made significant contributions to the research framework, addressing the human dimensions of climate change.

In 2008 the University of Nebraska launched the Water for Food initiative, with the goal of forming a research, education and policy analysis institute with a global reach that would address the critical challenge of growing more food using less water. This is one of the largest and most complex challenges facing our nation and the global community. It demands our best ideas and an interdisciplinary approach, not only to find ways to produce more food with limited water supplies but also to change human attitudes and behaviors that prevent us from using water efficiently. Nowhere are the human dimensions of research more important than in the issues of food and water security, which go directly to the sustainability of life on the planet.

In April, 2010 the University of Nebraska was fortunate to receive a $50 million founding gift commitment from the Robert B. Daugherty Charitable Foundation to support the global Water for Food Institute, now re-named the Robert B. Daugherty Water for Food Institute. Policy analysis, along with research and education, is one of the three focus areas of the WFI. All facets of the Institute's work must address the human dimensions. Law, economics, psychology, sociology, political science and other social and behavioral science are playing an important role in the Institute's work. It is an amazing opportunity to bring together faculty from many disciplines to create innovative programs that address a global need.

The expanding definition of human dimensions. Today the definition of human dimensions has expanded to include social and behavioral science research in fields beyond the natural sciences. The Department of Defense funds work in the human dimensions of military operations and of strategic leadership. Human dimensions have become an important topic in nanotechnology and nanoscience, because of societal fears of health threats from new materials. Human dimensions or human factors are important areas of research in fields as diverse as computer science and transportation engineering. This emphasis on human dimensions offers important new opportunities in social and behavioral science research and is leading to creative research approaches to many of our most complex societal challenges.

The Importance of Social and Behavioral Sciences Research

The social and behavioral sciences play a critical role in the intellectual life of the university and the research enterprise. The stature of every major university is measured in part by the strength of these disciplines, and research and scholarship in these sciences is an important driver of excellence in teaching

and the training of the next generation of scholars. Research in these disciplines is critically important in meeting major challenges facing our society in education, national security, human health and well-being, food and water security, climate change and other areas.

Despite the need for this research, funding from the federal agencies for these disciplines (with the exception of education) has lagged far behind that available for engineering and the physical and biomedical sciences. This is beginning to change, driven in part by the emphasis on the human dimensions of complex societal problems, in part by the need to push research out of the lab and into the larger society where it can contribute to potential solutions.

The Role of Social and Behavioral Research in National Initiatives

The National Science Foundation (NSF) and National Institutes of Health (NIH) are two examples of funding agencies where the social and behavioral sciences – and the human dimensions – are being emphasized more and more. At NSF, each proposal received must address the broader impacts of the research. Two questions from the description of broader impacts are:

- Will results be disseminated broadly to enhance scientific and technological understanding?
- What may be the benefits of the proposed activity to society?

These two questions basically address the human dimensions of the research. How will research – in any field – be communicated to and benefit society? This defines a key role for social and behavioral sciences in NSF competitions.

At NIH there is a similar emphasis on the dissemination and implementation of health research, aimed at closing the gap between experts and health care providers. The goal is to push the research out of the lab and into the hands of practitioners, where it can benefit society. Translational research is a priority at NIH. It focuses on improving patient access, reorganizing and coordinating systems of care, helping clinicians and patients to change behaviors and make informed choices and providing decision-support tools – the very definition of the human dimensions of research.

There are similar emphases now in many large-scale initiatives, which require significant educational, outreach and dissemination components that can best be addressed through the involvement of social and behavioral researchers. In today's intense competition for funding a proposal that does not address some aspect of human dimensions/social and behavioral research often will not be successful.

Support for Social and Behavioral Science Research at UNL

The past decade at UNL has seen a significant emphasis on engaging and supporting social and behavioral scientists. These activities include:

- Interdisciplinary retreats to establish relationships among diverse disciplines
- Internal grants competitions to create research clusters
- Bringing program officers from federal agencies and private foundations to campus
- Targeted hires

- Extensive support for development of large-scale proposals
- Support for conferences, workshops

These activities are not unique, but we have pursued them consistently over many years and it has made a real difference in establishing strong research programs and building expertise in key areas. A few of these are described below.

Social and Behavioral Science Centers. Several well-established centers at UNL are based in social and behavioral science disciplines. These are highly successful centers that generate well-funded research within their fields. They also are important collaborators who add human dimensions research to proposals in engineering and the physical and biomedical sciences.

Nebraska Center for Research on Children, Youth, Families and Schools

This center conducts interdisciplinary research to promote the intellectual, behavioral, and social-emotional development and functioning of individuals. Areas of research include:

- Early childhood education and intervention
- Academic intervention, instruction and learning
- Youth risk, resilience and health promotion

National Center for Research on Rural Education

The center's research contributes to data-based understandings of what works, for whom, and under what conditions in the rural context in the areas of instruction/education, professional development of teachers, and related issues.

University of Nebraska Public Policy Center

The Center provides the opportunity for policy makers and researchers to work together to address challenges of local, state, and federal policy. Center researchers come from diverse disciplines, including: Business, Economics, Family and Consumer Sciences, Law, Political Science, Psychology, and Sociology.

Center for Children, Families and the Law

This center is a home for interdisciplinary research, teaching, and public service on issues related to child and family policy and services. The knowledge generated and synthesized by the Center is widely disseminated to educate policy makers, scholars, service providers, and the general public.

Social and Behavioral Health Research. Listed below are highlights of a few UNL research projects, though many other researchers work in these areas.

Sexual Revictimization: Emotional and Psychosocial Mechanisms, Dr. Don DiLillo

A $3.1 million grant from NICHD to study the processes by which childhood or adolescent victimization is linked to adult revictimization.

Alcohol Use in American Indian Adolescents; Causes of Homelessness in Women; Community-based Research on Racial/Ethnic Minority Populations; Dr. Les Whitbeck

Dr. Whitbeck is a national leader in research on ethnic and minority populations.

Bullying: Risk Factors and Consequences; Dr. Susan Swearer

For more than a decade Dr. Swearer has been a leader in bullying research, which has suddenly gained prominence on the national agenda. She served on an expert panel at the 2011 White House Conference on Bullying Prevention.

Human Trafficking

This important international issue was brought to our attention by an interdisciplinary faculty team that includes journalism, law, economics, family and consumer sciences and psychology. They have received support for an annual conference and for a consultant to help with proposal development. It is an interest case study, because while the conferences have been very successful, finding funding for this work is extremely difficult – as is often the case in some areas of social and behavioral science research.

Integrating the Social and Behavioral Sciences with the Natural and Physical Sciences

An important element of our support for social and behavioral research at UNL has been our insistence on interdisciplinarity and the integration of those disciplines with the physical and natural sciences, where possible and where it makes sense.

For instance, retreats around key initiatives always emphasize the inclusion of social and behavioral science researchers as a way of connecting faculty and building potential partnerships. In giving internal support for large-scale science proposals we emphasize building in studies of the human dimensions that include researchers from education, policy, economics, psychology, sociology and other disciplines.

This has led to innovative ideas and initiatives, increased funding opportunities and more funded proposals for faculty in the social and behavioral sciences. Below are some examples of projects where we believe we have very successfully integrated the social and behavioral sciences with engineering and the biophysical and biomedical sciences.

Nanoscience and Human Dimensions. Nanotechnology is a field that is generating a great deal of discussion about potential risks and hazards. Many people who do not understand the science are fearful of what these new materials might mean in their lives. The UNL project NIRT: NanoManufacturing and Analysis of Active Hierarchical Nanofilamentary Nanostructures was funded by a $1 million NSF grant. It includes a study that focuses on the perceived and real dangers of nanomaterials and their effect on research and public policy, and includes faculty from our Public Policy Center and College of Law. This is an example of how addressing the human dimensions of leading edge research may help to divert social concerns as the technology evolves.

Center for Brain Biology and Behavior. This is a newly proposed interdisciplinary center that brings together psychologists, political scientists, biologists and engineers to study brain concussion, human performance, and correlation of human behavior with genetics. This is also a unique collaboration between academics and athletics. The center has attracted a new talented colleague, Dennis Molfese, to the university who is a renowned brain expert and is providing leadership for this center. A new facility is being constructed in collaboration with

the Department of Athletics to house this center. The university has made major investments in support of this new center including acquisition of whole body functional magnetic resonance imaging equipment. This collaboration has been received enthusiastically at the university.

Natural Science and Human Dimensions. A UNL IGERT project, "Resilience and Adaptive Government in Stressed Watersheds," addresses the scientific, socio-economic and legal aspects of managing and governing watersheds. It is training 26 doctoral students drawn from law, natural resources, political science and computer science, a truly interdisciplinary and human dimensions approach to the management of water resources.

Communicating Health Science. A UNL project called "World of Viruses," funded by a Science Education Partnership Award from NIH, is an exciting example of innovative ways to translate and communicate biomedical science to young people. "World of Viruses" began as a book, evolved into comic books, and apps for mobile phones and one of the very first apps for the iPad. Experts in virology, journalism, computer science and graphic design combined their skills to produce these award-winning products for health messaging to young people about HIV, HPV and influenza.

Closing comments:

Our experience in fostering interdisciplinary collaboration amongst social sciences, physical sciences life sciences research has met with some success. The major hurdle is lack of knowledge amongst faculty about mutual research interests and expertise. Interdisciplinary faculty retreats, bringing faculty from multiple disciplines together on special topics and seed funding for new collaborations have been helpful in forming successful teams. It is also critical that we as a nation support social and behavioral science research as disciplines to ensure research and scholarship in those disciplines is nurtured and scholars are available for the future. Demand for scholars in social and behavioral sciences that are equipped with skills and tools to deal with human dimensions is only going to increase as global society faces challenges in dealing with health, food security, national security, climate change and national competitiveness.

Functional Neuroimaging Studies of Obesity: Linking Neuroscience to Health Behavior

Cary R. Savage, Director, Center for Health Behavior Neuroscience; John H. Wineinger Professor of Psychiatry and Behavioral Science, University of Kansas Medical Center

The theme of this year's Merrill Retreat was "Behavioral and Social Sciences as Key Components in National Research Initiatives." I was invited to participate as a Research Faculty panel member. In this role, I presented a short overview of our research efforts aimed at understanding the neurobiological mechanisms underlying overeating and obesity and how we are moving these advances in neuroscience into the realm of clinical and behavioral intervention. I believe our efforts from the KUMC Center for Health Behavior Neuroscience provide good examples of the fundamental importance of behavioral and social sciences to advancing national research initiatives on the obesity epidemic. In this paper, I will overview the obesity problem and our research efforts aimed at defining brain function differences between obese and healthy weight groups, and then linking brain function to success or failure in diet and exercise interventions.

The "Epidemic" of Obesity. *Obesity rates are on the rise and associated with serious public health consequences and rising health care costs.*

Overweight and obesity are defined by a body mass index (BMI) of 25 to 29.9 and 30 or greater, respectively. A certain percentage of the human population has always been obese. Before 1990, approximately 10-14% of adults in the U.S. were obese as defined by a BMI > 30. Since 1990, however, rates of obesity have increased dramatically, to the point that over 30% of the U.S. adult population is now obese (Ogden et al., 2006). In fact, if rates continue unabated, approximately 75% of the adult American population will be overweight or obese by the year 2020 (Wang et al., 2011). Increases in obesity prevalence in children are comparable to those found in adults (Ritchie et al., 2003) and portend continued increases among adults.

Obesity is associated with significant public health consequences. Both overweight and obesity are characterized by the accumulation of excess levels of body fat and contribute to Type 2 diabetes, heart disease, hypertension, stroke, some cancers, osteoarthritis, as well as psychosocial and economic difficulties such as work disability (Mokdad et al., 2003). Not surprisingly, obesity also has dramatic impacts on increasing health care costs. Recent estimates of the total costs of obesity in the U.S. are over 140 billion dollars per year (Finkelstein et al., 2009). There are also secondary costs of obesity that may be surprising. For example, cars now burn more gaso-

line to transport our larger body masses. In 2006, Jacobson and colleagues (Jacobson et al., 2006) estimated costs of increased automobile gasoline consumption attributable to obesity at 2.2 billion dollars per year. Using these estimates and current gasoline prices (~$3.50/gallon), obesity increases automobile gasoline costs in the U.S. by approximately 3.5 billion dollars per year. This is cars only; other costs of transportation (e.g., airlines) are similarly increased.

Given the demographic changes, associations with negative health consequences, and economic burden, it is easy to justify the use of labels such as "epidemic" to describe the obesity problem in the U.S. and other developed countries. On a more optimistic front, weight loss has been shown to diminish risk for disease. Numerous studies have shown the beneficial effects of diminished weight and body fat in overweight and obese individuals. Weight loss has been shown to reduce blood pressure, improve cholesterol, improve glucose tolerance, and reduce markers of inflammation (associated with heart disease). While weight loss of 10% is generally recommended, improvements in disease risk factors have been demonstrated with as little as 2-3% weight loss (Truesdale et al., 2005). There are, therefore, strong reasons to develop better interventions for obesity.

Societal Changes Leading to the Obesity Epidemic. *We live in a society where food is plentiful and exercise is optional.*

Obesity is a complex medical and behavioral problem that boils down to a very simple cause: consistent energy intake in excess of daily energy requirements. The old adage "calories in vs. calories out" is true, and changes at the societal level have contributed to chronic energy imbalances and, therefore, obesity.

Until very recently in our evolutionary history, acquisition of calories for consumption required work. First, we hunted over long distances for animals and plants. In fact, humans lived nomadic lifestyles, constantly on the move in search of sources of food and water. Later, farming and livestock management techniques allowed us to remain geographically stable, but even these methods required long hours of physical labor. This is no longer the case. Americans and other western citizens now live a privileged life. We drive from place to place in comfortable, climate-controlled cars. We complain if we have to walk more than a few feet from our cars to our places of work. We spend our days in the sitting position, working on computers. We even use "drive-up windows" to acquire food. We can, without expending any calories beyond baseline metabolism, drive up to a window, and for a few dollars, have literally thousands of calories handed to us from a window.

Food portion sizes have also increased. An article in National Geographic Magazine (Newman, 2004) includes a startling graphic summarizing changes in portion sizes of common food and drink items. For instance, average portion sizes for a cheeseburger have increased from 202 calories to 310 calories; fries from 210 calories to 610 calories; a serving of "Coca-Cola" from 79 calories to 194 calories; a serving of pop-

corn from 174 calories to 1,700 calories. Even our leisure is now effortless. The average American spends 2.7 hours per day watching television and another half-hour per day on a computer for leisure (Bureau of Labor Statistics, 2010).

Given all these changes in lifestyle, it is easy to see how energy imbalances occur and add up over the years to create obesity. Magnified across a population, we end up with a societal obesity epidemic. The solution is easy – eat less and exercise more – yet, it is highly elusive. Though the population tipping point has arisen from large-scale societal changes, biology plays a critical role in determining poor health choices at the individual level. Research is now aimed at understanding the biological roots of this resistance to healthy decision-making.

Eating and the Brain. *Why it is so hard to "Eat Less and Exercise More"*

I noted previously that the availability of plentiful, calorie dense, food is a recent development in modern society. It turns out that our brains have not kept up with these rapid changes. We remain biologically driven to consume calories whenever possible and move as little as needed to conserve energy. These drives are largely regulated by the brain. Health behaviors, such as eating, are influenced by a convergence of processes in the brain, including homeostatic factors and motivational and reward processing. Motivation and reward processing are especially important contributors to overeating and sedentary lifestyle in humans (Wang et al 2004). For example, food is a highly salient reinforcer (Epstein et al 2007) and its presentation is associated with increased activity in limbic and paralimbic networks in the brain – these very brain regions play critical roles in helping us prioritize our attentional and behavioral resources. Abnormal activity in these networks may lead to increased susceptibility to overeating and other maladaptive health choices. As such, overeating and obesity may be conceptualized as reflecting failures in impulse control that are associated with unique patterns of brain activity.

Despite our biological programming, not all people become obese. Even dire predictions for the obesity epidemic predict that 25% of the U.S. population will remain healthy weight in 2020 (Wang et al., 2011). There are clearly important individual differences in the drive to eat and remain sedentary. The remainder of this chapter will focus on our attempts to understand differences in brain function that contribute to overeating and sedentary lifestyle.

Neuroimaging Efforts – Defining Brain Function in Obesity. *There is now consistent evidence of altered brain function in obese groups*

Recent advances in functional neuroimaging techniques have provided the opportunity to noninvasively study brain function differences between obese and healthy weight groups. The most widely used neuroimaging techniques include positron emission tomography (PET) and functional magnetic resonance imaging (fMRI). PET uses radioactively labeled isotopes to measure brain glucose metabolism or blood flow, while fMRI takes advantage of unique properties of oxygenated and deoxygenated hemoglobin in a magnet to provide measures of hemodynamic response (changes in brain blood flow and oxy-

genation) associated with changes in mental state.

Although few in number, initial studies in obese adults have identified specific modifications of function in neural networks in comparison to healthy weight subjects. One research group produced most of the early published studies of obesity (Gautier et al 2000; 2001; DelParigi et al 2002; DelParigi et al 2005), all using PET and liquid meal tasting after prolonged fast. For example, DelParigi and colleagues (2002) used PET to examine regional cerebral blood flow in healthy weight and obese adults. Participants were scanned in two sessions, when hungry (after a 36 hour fast) and when consuming a satiating liquid meal. In the hungry condition, the obese group showed greater increases in brain blood flow to liquid tasting in the insula and cingulate cortex. After consuming the satiating liquid meal, differences were observed in the hippocampal formation, cingulate cortex, and amygdala. These findings implicate brain regions known to play a role in taste, reward, and behavioral control.

Our research team has now published several studies in obese and healthy weight groups. In these studies, we scan participants with fMRI as they view food and nonfood pictures (e.g., Bruce et al., 2010; Martin et al., 2010). We had previously validated these images in studies to identify food pictures that were maximally appetizing and nonfood pictures that were not appetizing but were nonetheless rated as equally positive and interesting. We scan participants in two sessions: Once after fasting at least four hours (Pre-meal condition) and once after eating a healthy 500 kcal meal (Post-meal condition). This approach enables us to examine brain function differences during states of high food motivation (Pre-meal) and lower food motivation (Post-meal). This approach can be used in both adult (Martin et al., 2010) and pediatric (Bruce et al., 2010) populations. We have found that both obese children and adults show greater brain activation to appetizing food pictures in brain regions similar to those found in previous studies studying brain function while consuming liquid meals. We have also demonstrated that these differences in brain function are correlated with self-report ratings of eating behavior. For example, Figure 1 illustrates a result from Martin et al. (2010), highlighting a region in medial prefrontal cortex that is hyperresponsive in obese subjects and also

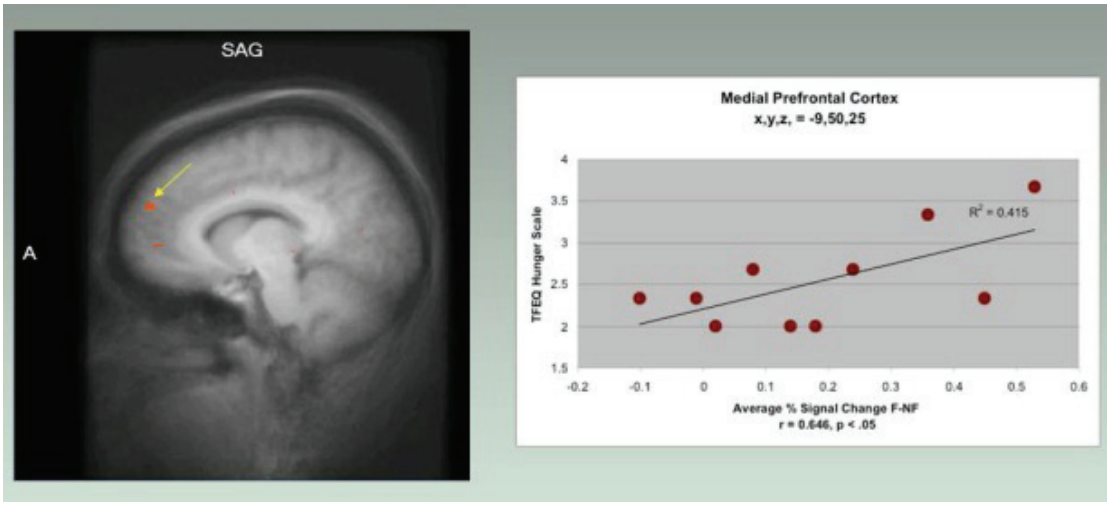

Figure 1

positively correlated with self-report ratings of hunger.

Thus, our initial functional imaging studies have identified brain regions that respond differently to visual food cues in obese and healthy weight individuals, and are positively correlated with reports of hunger in obese participants. These brain areas are known to be involved in the processing of taste, reward, and behavioral/cognitive control. While shedding some light on mechanisms of overeating, many important questions remain. For instance, it is not yet known whether brain activation patterns change after dieting, or if they change differentially in successful and unsuccessful dieters. In addition, little is currently understood regarding biological processes that contribute to long-term maintenance of healthy weight. These missing pieces highlight the need to link neurobiological findings to actual health behaviors.

Linking Neuroscience to Health Behavior – Diet. *We are investigating brain function predictors of weight loss and weight loss maintenance in diets*

One major goal of our current research efforts is aimed at linking brain function differences to different outcomes in diet interventions. To achieve this goal, we established a collaboration with the Energy Balance Laboratory of Dr. Joseph Donnelly. We received NIH R01 funding in 2008 (DK080090) to support a project in which we scan obese and healthy weight participants with a the food motivation fMRI paradigm, described previously, during a baseline state and after obese participants have completed a twelve-week diet-based weight loss intervention. Obese participants are then followed though a 6-month weight maintenance period. Our project has three Specific Aims:

1. Characterize brain activation underlying increased food motivation and impulsive eating in obese individuals.

2. Identify brain activation predictors of initial weight loss.

3. Identify brain activation predictors of weight loss maintenance.

We have now completed analyses of fMRI data from the Baseline session. In these analyses, we examine fMRI predictors of future success or lack of success in the 3 month diet intervention. "Successful dieters" are defined as those who lose at least 7% of starting body weight, while "unsuccessful dieters" lose less than 7%. Initial analyses indicate that the future unsuccessful dieters show two important differences in brain activity when viewing food pictures before dieting: First, they have decreased activity in prefrontal cortex; second, they show increased activity in the sensorimotor regions of the brain corresponding to mouth and tongue. Thus, our preliminary data indicate that unsuccessful dieting is predicted by decreased activity in parts of the brain implicated in behavioral inhibition and control (prefrontal cortex) and increased activity in the areas of the brain controlling the mouth and tongue. These results provide important clues about resistance to weight loss in diets. We are now analyzing the longitudinal data from the study in order to identify predictors of 6-month weight loss maintenance.

Linking Neuroscience to Health Behavior – Exercise. *We are also investigating brain function predictors of adherence to*

exercise programs and the beneficial effects of exercise on brain function

Our group has more recently begun a collaboration with the Energy Balance Laboratory on an NIH R01 (DK085605) funded study designed to examine predictors of adherence to a 9-month exercise program. Regular exercise is a critical component of maintaining energy balance and it is associated with health benefits, including enhanced brain function. Health-related decisions, such as whether to exercise, are influenced by a convergence of processes in the brain, as individuals weigh the perceived balance between the rewarding and punishing aspects of the behavior, and whether gratification is immediate or delayed. Healthy behaviors are in part difficult to maintain because they are less immediately gratifying. In fact, exercise may initially be perceived as aversive. Despite this challenge, some people are able to persevere and experience long-term benefits. We hypothesize that brain processes underlying reward processing and impulse control will help us better understand mechanisms of obesity and health-related decision making. With this goal in mind, we are scanning participants as they gain and lose money and as they make monetary choices between small immediate rewards and larger delayed rewards. Scanning will take place before and after a nine-month exercise intervention.

The study addresses three Specific Aims:

1. Characterize brain activation underlying reward processing and impulse control in obese and healthy weight individuals.

2. Identify brain activation predictors, from the Baseline Session, of adherence and success in the exercise program.

3. Identify the beneficial effects of exercise and increased fitness on brain activation.

We predict that measures of brain activation will be useful in identifying neural contributions to obesity, determinants of adherence to a long-term exercise program, and the beneficial effects of exercise on brain function. This study is currently underway.

Summary. *Early attempts to link behavioral and social sciences to obesity research initiatives show real promise*

Obesity is a critical and growing problem in the U.S., with alarming health and economic ramifications. Previous work has linked obesity to altered functioning in brain networks supporting taste, reward, and cognitive control. The next challenge is to link these brain function differences to interventions designed to moderate food consumption and increase physical activity. The Center for Health Behavior Neuroscience was formed at the University of Kansas Medical Center (KUMC) in 2010 to support and unify research efforts at KUMC that are focused on brain function contributions to obesity, addiction, and other health behaviors. This paper has summarized some of our initial efforts aimed at linking neuroscience findings to healthy and unhealthy behavioral choices and response to intervention. As such, it highlights the importance of "Behavioral and Social Sciences as Key Components in National Research Initiatives."

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Dilemmas and Opportunities Surrounding Participatory Research to Promote Health in Small Towns

Elaine Johannes, Associate Professor and Extension Specialist, School of Family Studies and Human Services, Kansas State University

Small Town Dilemmas: The 2010 census confirmed what most Kansans already knew about the state's population surging in urban areas while declining in small towns and rural areas. At the writing of this article, a number of state-supported efforts are underway to recruit businesses to rural Kansas, to sustain resources and to retain young people. Specifically, Governor Sam Brownback's "Rural Opportunity Zones" (ROZs) are designed to reverse dramatic population declines over the past decade in rural areas of Kansas through income tax exemptions and student loan forgiveness. Even if these steps are successful in the short-term, some experts consider them to be futile in long-term solutions to the "hollowing out the middle".

"Hollowing Out the Middle" is the title of a book by sociologists, Patrick Carr and Maria Kefalas (2009), which describes the de-population of rural areas and small towns due to lack of well-paying jobs, viable schools and adaptive leadership. A conclusion that Carr and Kefalas draw from their twelve month study of small towns in the Midwest is that there is little that policies and public supported programs can do to stem out migration. However, if a small town builds social capital between different sectors, engages young people through leadership opportunities and improves community amenities the town is likely to sustain its unique quality of life and to thrive. But how do leaders in small towns accomplish these results when human, financial and natural capitals are limited? Working through volunteer networks comprised of youth and adults around issues of health for all residents, Kansas State Research and Extension's ***Get It – Do It!*** program has helped small towns move towards sustained quality of life and thriving.

***GET IT – DO IT!* – Whole Town Participation in Health Promotion**

According to the Centers for Disease Control and Prevention (2006), not only is an individual's health affected by their community, but the health of whole communities may be inseparable from the health of individuals and families. Consequently, whole community efforts are most effective in increasing physical activity levels and improving health status among residents. Additionally, Flora and Gillespie (2009) found that targeted programs that increase the social, built and human capitals of communities can result in health and quality of life improvements.

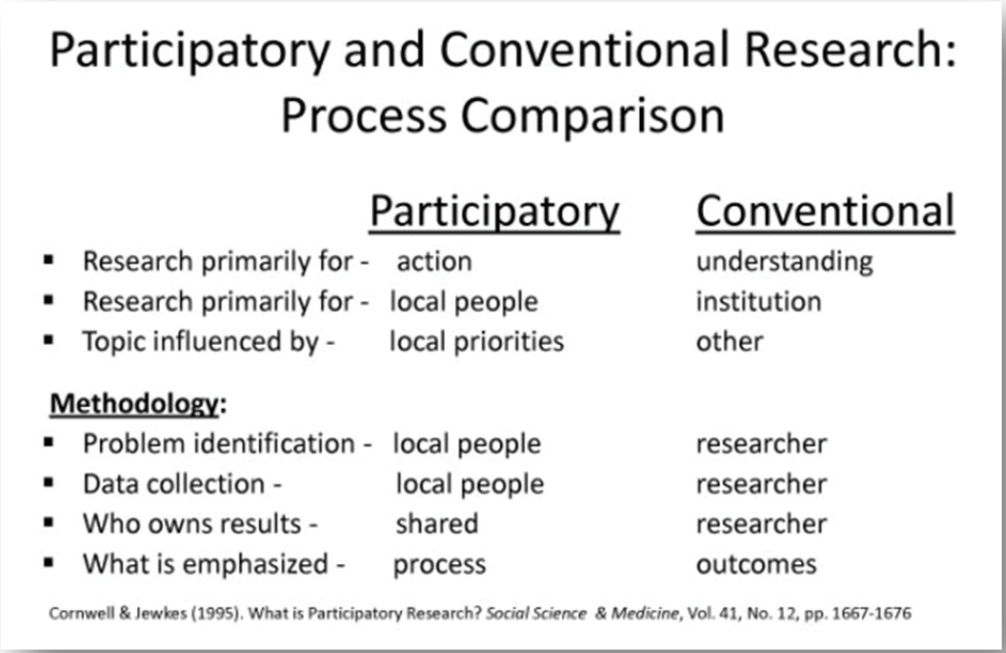
Unfortunately, many small towns and rural areas in the United States lack

access to the resources or workforce necessary to appropriately adapt health promotion strategies to the unique contextual, cultural features of small towns. This dilemma is compounded when social science researchers and program implementers assume that community members are merely recipients of programs and aren't engaged participants and decision-makers. Successful and sustainable efforts to improve the health of small town citizens require a community development – participatory approach which is distinct from the traditional expert service delivery model.

Cornwell and Jewkes (1995) have made a convincing argument for active participation of communities involved in health programs and/or social science research. They contend that the conventional research process is not conducive to sustaining results since community members feel no investment in the program or its results. Simply put, program implementers have not given ownership of the program to the people impacted by it. In a participatory process, the people along with the researcher/implementer own the results.

Consequently, Kansas State Research and Extension developed the *Get It – Do It!* program in 2007, using a community-based participatory approach. The goals of *Get It – Do It!* are to:

- Foster youth-adult partnerships
- Engage youth in meaningful roles
- Enhance social capital (bonding, bridging, reciprocity)
- Support local community development vision



Participatory and Conventional Research: Process Comparison

	Participatory	Conventional
▪ Research primarily for -	action	understanding
▪ Research primarily for -	local people	institution
▪ Topic influenced by -	local priorities	other
Methodology:		
▪ Problem identification -	local people	researcher
▪ Data collection -	local people	researcher
▪ Who owns results -	shared	researcher
▪ What is emphasized -	process	outcomes

Cornwell & Jewkes (1995). What is Participatory Research? *Social Science & Medicine*, Vol. 41, No. 12, pp. 1667-1676

- Increase health-promoting opportunities (e.g. park improvements, summer camps, trail development, out-of-school health programs)

Get It – Do It! accomplishes these goals through networks of youth-adult partnerships in small towns that receive seed money, training and support from local intermediaries to increase opportunities for physical activity, improve built environments and strengthen community social capital. Of special focus is increasing the engagement of young people where by increasing their sense of community attachment through community-based participation.

Kansas *Get It – Do It!* has worked with ten small towns (population ranges from 178 to 2,500) which successfully competed for $3,000 grants, recruited youth and adult partners, completed community assessments, participated in 16 hours of health promotion training (e.g. CATCH, NIH's "Media Smart", community park assessment, youth development), implemented projects that promoted healthy activity and engaged in a thoughtful evaluation of their work. Each *"Get It – Do It!"* community promotes health through their unique micro-projects implemented by youth-adult partnerships. The local projects are designed with the "cornerstones of effective and sustainable community health promotion" in-mind. Those cornerstones are:

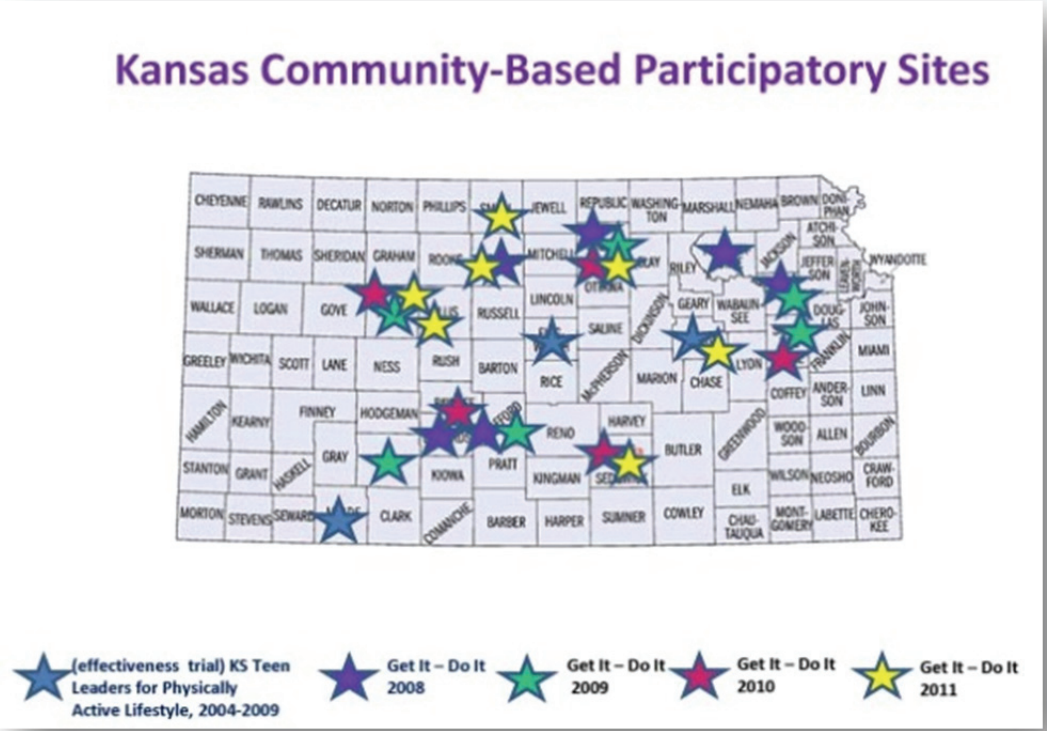
- **Access** to healthy foods, places and opportunities to engage in physical activity.
- Establishing meaningful partnerships across generations.
- **Understanding the science** behind effective health promotion and youth engagement.
- **Increasing the capacity** of everyone (paid workers and volunteers) participating.

- **Increasing awareness and understanding** of the value of healthy living through effective, appropriate and targeted communication.

(from: "Blueprint for Nutrition & Physical Activity: Cornerstones of a Healthy Lifestyle". Association of State & Territorial Public Health Nutrition Directors, 2008)

Local *Get It – Do It!* projects involve voluntary community improvement organizations (i.e., PRIDE) and youth groups (e.g., schools, scouts, 4-H clubs, faith groups) working together to promote physical activity and healthy eating. Since 2007, youth and adult partners have improved physical activity places (e.g., parks, trails, skate parks), implemented youth-led health promotion activities (e.g., summer health camps, walking clubs, HealthFest celebrations) and addressed policies that impact health (e.g., bike riding down town, food choice during high school lunch, selection of park equipment) at varying degrees in the small towns.

At the state level, Kansas State Research and Extension introduces resources, training, technical assistance and evaluation support to the youth and adult networks. At the local level, Extension professionals serve as intermediaries communicating the results of the project to the media and surrounding towns, providing training as necessary, and helping with *Get It – Do It!* evaluation (photovoice, observation, survey collection).



In 2010, *Get It – Do It!* communities involved over 1,500 rural individuals and generated nearly $75,000 in-kind through volunteer involvement. Local

projects have also improved built capital such as town squares, parks, walking trails, skate parks and have used those places to launch health promotion campaigns and activities.

Most importantly, the small towns have discovered that promoting health is a viable way to engage young people and to build leadership skills and community attachment among youth.

***Get It – Do It!* - Results**

In addition to improving infrastructure for health and increasing opportunities to practice healthy behaviors, *Get It – Do It!* communities have learned how to foster youth-adult partnerships which lead to more engaged youth and stronger community social capital. Program evaluations confirm those results.

Get It – Do It! uses a multi-faceted evaluation which includes:

- Surveys - Youth completed pre, post assessments of social capital belonging using Tolan, Gorman-Smith & Henry's (2001) *Community Belonging* survey. Youth and adult mentors also completed the *Youth Involvement/Engagement* survey (Jones, K., 2006; Jones & Perkins, 2006) pre, post which measures social capital reciprocity. At the end of the project, groups of youth from each community participated in an interactive community mapping activity (Emery, Baker, Calvert, Enfield & Williams, in press) which assesses social capital impact.
- Observations - Third party observers, trained to identify evidence of youth involvement based on Hart's (1992) model of youth participation, were deployed quarterly in the communities to observe youth-adult interactions during project activities and community events.
- Photovoice - Youth, provided with cameras and a secure website for downloading/posting, reported activities and results of projects through photos.
- Intermediary reports - Telephone conference calls to local Extension personnel serving as intermediaries/key-informants provided information about the organization, process and sustainment of the project.

Survey results thus far for 2011 indicate that:

- Youth participant feelings of loyalty to their towns increased.
- Youth participant feelings of belonging increased.
- Youth participant desire to live in a small town as adults increased.
- Youth participants developed new skills by helping one another through the projects.
- Youth and adults established effective partnerships, where none existed previously, through the projects.

These findings give positive direction to rural areas and small towns wishing to recruit, re-energize and retain young people as community leaders and engaged citizens.

Lessons Learned: Dilemmas Lead to Opportunities

Local *Get It – Do It!* projects spring from the dreams and drive of community volunteers – young and old. That volunteer drive is essential for engaging youth, for sustaining the project in mid-course, and involving the whole town. In most cities, involvement by everyone may be impossible, but in small towns everyone is involved because the town depends on it. The *Get It – Do It!* project of Grinnell, KS is a good example. At the end of the 2010 *Get It – Do It!* project in Grinnell the town had a picnic to discuss what was accomplished for the year and to demonstrate the new park equipment that was designed for abled and not abled alike. The community picnic was attended by 80 people which were 30% of the town's population of 269. Imagine a city getting one-third of its total residents in one place for over four hours to celebrate with each other, welcome new residents, learn about health from young people and plan more opportunities for health!

One must be realistic, however because community-based participatory projects pose dilemmas that can become challenges. Implementers must keep in-mind that:

- Working with local people is far from easy because word travels quickly and everyone knows everyone.
- Not all are motivated to be involved so the leaders (youth and adults) can become exhausted by the project.
- Enthusiasm for the project may wane, and others may be hesitant to step-in because they don't want to offend the "champion".
- If the "champion" leaves the community, then others may follow.
- Small, rural communities are complex given the kinship connections, meaning of historical events and the on-going threat of depopulation.

Simply, the researcher and program implementer must be aware (and be appreciative) of those dynamics, must communicate clearly and frequently with everyone involved. The researcher must also be willing to allow the research agenda to be secondary to the primary objective of building community social, human and built capital through participation.

There are opportunities when working with small towns that large cities don't provide. Specifically, from an Extension professional's standpoint, Fran Richmond, Director of the Frontier Extension District, said that *"The Get It – Do It!" program is a program with great potential for replication across the state. Many communities could benefit from the educational information regarding process and partnerships. The seed money to help small towns follow through with their dreams is important and needed. When communities are taught planning skills, and given support to reach their goals, great things happen."*

Though Kansas State Research and Extension provided the impetus through *Get It – Do It!* to improve health and strengthen social capital, it has been up

to the youth and adults to design and implement projects that are informed by science and tailored to the uniqueness of their small town. An important lesson learned by this author through these projects is how important self-determination is.

In the words of Joan Nothern, Glasco PRIDE, "*The concept of each community building its own project to meet its own defined needs conveys a respect that really promotes the will to deliver and deliver again."*

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Behavioral Sciences and Drug Discovery

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Many drugs discovered by our prehistoric ancestors are those affecting behavior. As this was not the result of an organized search for such agents, it reflects the fact that humans notice when consumption of a product alters their sensorium. In some cases the effect was perceived as beneficial, whereas in others it was dysphoric. Word of these discoveries was passed on for generations. Over the millennia, these products were employed for recreational or religious purposes, as poisons, for inducing sleep, or for enhancing endurance.

Defining the behavioral effects of chemical substances remains an important component in the modern era (~1850 to the present) of drug discovery. Typically agents are sought that provoke desirable, or diminish undesirable, behaviors. Behavioral test are employed to determine whether a drug candidate unintentionally modifies central nervous system function, with such an action often being considered a side effect or toxicity.

Given the ongoing need to define the behavioral consequences of potential pharmaceuticals and environmental agents, there is a critical need for research and training in the behavioral sciences. Unfortunately, support for such programs has waned. This is due to a flagging interest in the field on the part of funding agencies, and a decline in the hiring of behavioral scientists by the pharmaceutical industry. As detailed in several publications (Enna and Williams, 2009 a & b), including an earlier Merrill Series report (Enna, 2008), this reflects a general shift away from *in vivo* animal experimentation to *in vitro* assays for identifying and characterizing drug candidates. Provided below is a brief overview of how the behavioral sciences have historically played a major role in identifying important drugs and drug classes, the attempts made to develop new assays to substitute for detailed behavioral analyses, and efforts now being made to resurrect the behavioral sciences as a critical component of the drug discovery process.

Drugs and Behavior

In foraging for food, ancient humans would sometimes stumble upon plants or animals that provided something more than nutritional value. Occasionally, poisonous substances would be consumed, leading to illness or death. In other instances, constituents were ingested that had beneficial properties, such as anti-inflammatory, analgesic, or antimicrobial activity. Such effects would be noted only if the individual was consciously suffering from a condi-

tion that was moderated by the product. However, the medicinal value might be overlooked if a significant amount of time elapsed between its consumption and the therapeutic effect, as would be the case with antibiotics, making it less likely the person would relate the positive response to the ingestion of a particular foodstuff. It might also be missed if days or weeks of continuous administration were needed for a beneficial response. Because the human subject was not searching specifically for such agents, centuries of consumption might pass before therapeutic benefits were noted by a sufficient number of individuals to warrant the routine collection of a particular plant or animal species for such purposes.

Unlike agents used for treating a somatic illness or infectious disease, the effects of a psychoactive compound are often noticed soon after its consumption, whether or not the individual is suffering from a medical condition. Thus, psychedelics, central nervous system stimulants, sedatives, and convulsants would be readily appreciated by the consumer, and possibly by those around him, because the substance could affect behavior. Some agents still in use today that were discovered in the pre-modern era include morphine, psilocybin and other hallucinogens, the central nervous system stimulants cocaine, caffeine, and ephedrine, and ethanol, a sedative (Table 1). While the discovery of these substances did not result from well-designed behavioral studies, their early identification and exploitation by individuals who were scientifically unsophisticated illustrates the value of characterizing behavioral effects in identifying novel entities for treating central nervous system disorders, and for predicting certain side effects.

The serendipitous discovery of useful, centrally-active drugs did not end with the pre-modern era. In fact, a significant number, if not a majority, of centrally-active agents, and their chemical derivatives, that are used today were discovered empirically. Examples of psychotherapeutics discovered by accident in the modern era are iproniazide and imipramine, antidepressants that were originally developed as an antitubercular agent and an antihistamine, respectively, and chlorpromazine, an antipsychotic that was initially tested as an adjunct for general anesthesia. The therapeutic uses of carbamazepine, an anticonvulsant and an analgesic, valproic acid, an anticonvulsant and treatment for bipolar disorder, chlordiazepoxide, an anxiolytic and sedative, and modafinil, a psychostimulant, were all discovered empirically (Table 1).

Table 1

Neuroactive Drugs Discovered Empirically

Pre-Modern Era	Morphine
	Psilocyban
	Cocaine
	Ephedrine
	Iproniazide
Modern Era	Chlorpromazine
	Carbamazepine
	Valproic acid
	Chlordiazepoxide
	Modafinil

These examples, which are only a partial list of such drugs, illustrate how

keen behavioral observations made by astute clinicians and bench scientists opened new avenues for treating mental illness and other central nervous system disorders. For example, prior to the discovery of iproniazide and chlorpromazine there were no drugs that could be used specifically to treat major depression or to alleviate symptoms of schizophrenia. Chlordiazepoxide was a seminal discovery in that it revealed a chemical class, the benzodiazepines, that could, at the proper dose, relieve anxiety without causing profound sedation. Likewise, modafinil revolutionized the treatment of narcolepsy by maintaining alertness while, unlike amphetamine, not profoundly activating central nervous system activity.

Discoveries such as these spurred training in behavioral research. It was appreciated that such expertise was needed to understand and categorize normal and abnormal human behaviors so they could be properly studied in a clinical setting. It was also important for behavioral scientists to develop laboratory animal models of central nervous system disorders that could be used in drug discovery programs aimed at identifying new chemical leads. While progress was made in achieving these goals, much remains to be done. In particular, there are serious questions about the utility of animal models of major depression and psychosis in predicting the clinical efficacy of drug candidates. As many of these tests are based on behaviors induced by agents used to treat these conditions, it is argued that they are actually models of drug action, rather than of the clinical condition itself. For this reason, a drug candidate that displays possible therapeutic efficacy when examined in these models will, more than likely, have a cellular mechanism of action similar to the established agent, lessening its therapeutic impact. Accordingly, it is difficult to use such tests if the aim is to identify truly novel drugs for treating these conditions. What is needed, therefore, is additional information on the underlying neuropathology so that it can be induced, and its behavioral manifestations catalogued, in laboratory animals. As the resultant behaviors would have face validity, their modification could possibly be used to predict therapeutic potential regardless of the mechanism of action of the test agent. Until such information is accumulated, those interested in drug discovery must continue to rely on the observations of experienced behavioral scientists and clinicians for identifying new psychotherapeutics.

The importance of serendipity in the discovery of centrally-active agents has been acknowledged in the past by including a set of behavioral tests in early phases of the drug discovery program. One such battery was the Irwin test. Inclusion of a general behavioral screen left open the possibility that a neuroscientist or pharmacologist would note an unusual behavioral response early in the drug discovery process. If the compound-induced behavioral modification was perceived to have therapeutic potential, additional work could be undertaken to characterize the effect more fully to predict its clinical value. In this way novel, unanticipated, central nervous system effects would be noted and exploited for therapeutic benefit, as was done in a more haphazard manner in the

pre-modern and early modern eras of drug discovery.

Decline of Behavioral Research in Drug Discovery

As detailed extensively elsewhere (Enna, 2008; Enna and Williams, 2009 a & b), there was a significant shift in the design of drug discovery programs in the latter part of the 20th century. Until that time the major emphasis was generally on first identifying chemicals that displayed some type of therapeutic potential in intact animals or organ system tests, after which studies were performed to fully characterize their potential therapeutic efficacy, safety and mechanism of action. Of these various factors, mechanism of action was least important because then, as now, an understanding of mechanism is unnecessary for regulatory approval for human use, or for exploiting such an agent for clinical benefit. What is critical is that the chemical be shown to be safe and effective in humans.

This approach to drug discovery began to change in the 1980's, with initial tests being more focused on identifying chemicals that interact selectively, if not specifically, with known or suspected drug targets in the body. It was only after such compounds were identified using *in vitro* tests, that *in vivo* assays were performed to establish efficacy and safety in animal models of disorders thought to be related to the target site. Drug targets include enzymes, neurotransmitter and hormone receptors, ion channels, and transcription factors. This change in the approach to drug discovery from initially identifying compounds that display potential therapeutic activity in animals, to first designing selective ligands that interact with sites thought to be associated with the disorder of interest, was driven by several factors. Among these was the mapping of the human genome, which led many to believe it was just a matter of time before the genetic defects for many disorders were identified, thereby revealing the protein target that needed to be manipulated pharmacologically for therapeutic gain. It was also appreciated that *in vitro* screens of chemical libraries were much faster, more efficient, and less costly than labor intensive *in vivo* assays, such as those associated with behavioral tests. In addition, *in vitro* assays more readily lend themselves to automation, thereby speeding up the screening process and making it possible to test many more agents, in much smaller amounts, than *in vivo* assays. Automated tests were also appealing as they require fewer skilled scientists for execution and data analysis.

Automated *in vivo* screens, such as SmartCube and Pattern Array, were developed in an attempt to simplify and speed the assessment of test agents on animal behavior. These assay systems are capable of measuring a host of mouse behaviors in a short period of time and with little human oversight. By comparing quantified behavioral patterns between control animals, those administered a test agent, and archival data on the behavioral response to know centrally-active drugs, it is believed that predictions could be made about the behavioral effects of the drug candidate. While such tests can be an important component of a drug discovery program, they are not likely to detect an unusual response that might be noted by

an observant and trained behavioral scientist.

As a result of this shift in research emphasis, the number of scientists trained in organ system and behavioral pharmacology declined. This was accelerated by a number of related developments, but was driven primarily by stagnation, if not an absolute decline, in federal funding for research involving vertebrate animals (Table 2).

Because federal funding determines to a great extent the nature and direction of academic research, investigators became more focused on testing hypotheses relating to molecular and bio-chemical mechanisms than organ systems biology and the behavioral sciences. Besides taking advantage of the great strides being made in molecular biology, this shift away from *in vivo* assays had practical consequences in that it enhanced competitiveness for funding given the growing bias against such studies. As the number of funded behavioral scientists declined, fewer students pursued graduate work in the area. Over time, the cadre of faculty qualified to conduct research and to serve as mentors in the behavioral sciences diminished as well, both through natural attrition and the reluctance of institutions to hire such individuals because of the challenges they faced in garnering grant support (Table 2). This downward spiral ultimately lead to a shortage of scientists capable of conducting well-designed, and appropriately interpreted, *in vivo* laboratory animal studies in general, and behavioral experiments in particular. Some argue it is no coincidence that the loss of this expertise coincided with a significant decline in the identification of new drug candidates, especially those for the treatment of neurological and psychiatric disorders (Enna and Williams, 2009a).

Renaissance

Over the past decade there has been a renewed appreciation of the importance of whole animal studies in biomedical research. This was spurred in part by the growing lag time between discovery and clinical use of new drugs and other therapeutic modalities, and by the decline in the number of new product approvals in the face of ever increasing investments in drug discovery. To address these issues, the National Institutes of Health (NIH) launched the Roadmap program (Zerhouni, 2003) and the Food and Drug Administration created the Critical Path Initiatives (2004). Also, in 2006 the U.S. Government General Accountability Office (GAO) published a report detailing factors that slow drug discovery and development. Among those cited was a decline in the ability to translate basic biological discoveries into drugs. In short, the GAO tacitly acknowledged that the emphasis

Table 2

Consequences for Behavioral Sciences

- Decrease in federal research funding – slowing in the expansion of the knowledge base
- Decrease in training – decline in the pool of behavioral scientists
- Decrease in faculty with skills in the field
- Decrease in identification and validation of new drug candidates

on first characterizing molecular mechanisms in the search for new drugs had led to erosion in the expertise ultimately needed to develop chemical leads into viable drug candidates. Among the disciplines that were becoming underrepresented in this regard were the behavioral sciences, and both basic and clinical pharmacology.

The NIH Roadmap is designed to speed the rate of drug discovery and the dissemination of new therapies throughout the medical community. An important component of this undertaking is the Clinical and Translational Science Awards (CTSA's) that fund institutional initiatives in these areas. To be competitive for a CTSA, applicants are encouraged to include service or research components relating to behavioral assessments of health care providers, patients, or laboratory animals to help foster new drug development or the use of old drugs for new purposes. Both the United Kingdom and countries on the European continent have initiated similar programs. In all cases, it is acknowledged that efforts must be made to reestablish the importance of *in vivo* testing, behavioral observations and analysis in the drug discovery process. Because the expertise necessary for designing such tests is diminishing, funding agencies in the United States, United Kingdom, and Europe are underwriting training programs aimed at exposing biomedical scientists to the fundamentals of whole animal research. In the United States such efforts are exemplified by the Integrative and Organ System Pharmacology courses underwritten by the National Institute of General Medical Sciences (Preusch, 2004).

Conclusion

As the response to systemically active drugs and other xenobiotics typically involves the interplay of several organs and organs systems, the ability to understand such interactions, and to examine such effects experimentally, is an essential component of the drug discovery process. For a time, however, an obsession with defining drugs primarily in terms of molecular mechanisms led to devaluation of whole animal research and of detailed pharmacological analysis of the effect of test agents on organ system function and behavior. Besides the negative impact this shift in emphasis had on training in the pharmacological and behavioral sciences, it is also acknowledged to have contributed to a decline in the rate of new drug discovery. Given the proven importance of empirical observation in identifying novel drugs, even in the modern era, this consequence is not surprising. The renewed appreciation of the importance of whole animal and organ system research, and the appropriation of funds to reinvigorate training in these areas will help redress the imbalance in preclinical research emphasis in the search for new drugs . The evidence suggests that the most efficient and productive biomedical research programs should include equal measures of studies involving whole animals and organ systems and those aimed at characterizing the biochemical and molecular targets of the drug candidates. Those interested in the behavioral sciences should be heartened by these recent developments as they bode well for the future of this, and related, disciplines.

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Developing a Top 25 Program in the Behavioral and Social Sciences

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More than ever, public research universities are constrained in how much they can invest in program development in the social and behavioral sciences, as well as many if not all other disciplines. Without such investment, however, there is an inexorable decline in facility quality, including their ability to stay at the forefront of their disciplines and their ability to compete for federal research funds. In the face of diminishing State support and federal research funding opportunities, the ability to maintain and enhance these departments will increasingly depend on creative and sometimes risky strategies.

I describe policies that are in place at the University of Missouri and how I used these as the chair of the Department of Psychological Sciences (2002-2005) to facilitate changes that have better positioned the department to maintain and enhance its scientific reputation and federal funding.

There are two critical and central policies that allowed us to work toward "self enhancement" without the need for additional general operating funds. The first is the College of Arts and Science policy of allowing departments to keep general operating salary funds that are covered with federal or other grants and the second is the Office of Research Policy to return 25% of facilities and administration funds to departments. When I became chair, the departmental policy was to split these funds with the investigators 50/50. Our course load at that time was four courses per academic year, and investigators could buy out of one or all of these courses at 25% of their base salary for each course. Investigators used these funds to enhance their research productivity by supporting graduate students, research assistants, buying equipment, or covering their summer salary and the department used the funds to hire full time non-regular teaching faculty and to enhance start-up packages when recruiting new faculty, among other things. These policies create strong incentives for individual investigators to secure external funding and for departmental administrators to encourage grantsmanship.

In 2002, the contributions of the Department of Psychological Sciences to the University of Missouri were evaluated in terms of the size and effectiveness of the undergraduate and graduate programs; the scientific productivity and national reputation of the faculty members; the fiscal costs and benefits of operating the department; and, the potential for improvement in national reputation. Our goal was to determine changes

that needed to be made to become a nationally recognized top 25 department.

From 1997 to 2001, inclusive, the number of undergraduate majors had increased by 53% and faculty members had increased the number of undergraduate credit hours taught by 15%. The quality of this teaching was and remains high, as indicated by a mean Teacher Effectiveness Questionnaire (TEQ) rating of about 4.1 [on a 1.0 (low) to 5.0 (high) scale]. In the 1995 National Research Council (NRC) review of graduate programs, the Department of Psychological Sciences had the highest ratings in the University of Missouri system for faculty quality and program effectiveness. The NRC review covered 185 PhD granting programs in psychology (there are > 800 psychology departments nationwide), and the department ranked 67th in terms of faculty quality, and 59th for program effectiveness. These are certainly respectable ratings, but not anywhere near the top 25. We attracted good students (and now attract even better ones); of the 77 graduate students at that time, eighty percent had mean Graduate Record Examination scores that exceeded the university average. The department conferred about nine PhDs per year (and still does) who, in turn, competed very successfully for academic and clinical positions nationwide.

In terms of fiscal considerations and based on a University of Missouri system review of departments, operating costs for the department declined 13.6% between 1997 and 2001, inclusive, due in part to an increase in benefits paid through external grants. The estimated tuition generated by faculty members' teaching exceeded total departmental operating costs by roughly $500,000/year. In addition, the department generated roughly $500,000/year in facility and administration costs for the university. In all, the Department of Psychological Sciences contributed strongly to the undergraduate and graduate programs of the university and at the same time generated income.

To move the department closer to the ultimate goal of becoming a top 25 department, we determined that an evaluation and review of the teaching and grant release policies of the top 25 departments (based on 1995 NRC ratings) was necessary. I surveyed the chairs of these departments and determined that for top public research universities, the teaching load for psychology faculty members was three courses/year, with a grant release option of two courses; the teaching load for private universities was about two/year, but with less opportunity to obtain grant-based releases from teaching. We determined that our departmental policy of four courses each academic year placed us at a disadvantage relative to these departments, both in terms of the time available to faculty members for research-related activities and in terms of the recruitment and retention of the best scientists.

During the same five-year span (1997-2001), an increase in grant-related activities created additional demands on the associated support staff and the multiple and complex grants that had been awarded to several faculty members created additional grant-administration burdens. In other words, the department's external funding had reached a

level that would have been difficult to maintain much less increase without additional support staff.

To address these issues of teaching/research load policy and the added demands of increases in external funding – in light of the goal to further increase this funding and ultimately scientific productivity – the department proposed the following:

1. The institution of a "Research Intensive Track." As part of yearly evaluations, all faculty members are rated for their contributions to teaching, research, and service. Faculty who meet expectations for research contributions will be eligible for this track for the following academic year. The result for these faculty members will be a change in responsibilities from 40% teaching, 40% research, and 20% service, to 30% teaching (three courses each academic year), 50% research, and 20% service. These faculty members will thereby have a teaching/research load that is consistent with that of faculty members in top 25 public research universities.

An analysis of the impact of this policy yielded an estimated loss of six courses. To address this loss, the department proposed to use cost-savings funds to hire one additional full time (seven courses/year) non-regular faculty member to serve as an undergraduate instructor. The faculty members agreed to pay a higher cost (33% of base salary) for each course buy-out and to accept between 25% and 50% (depending on how many courses are bought out) instead of 50% of this buy-out, allowing the department to keep more of it. The individual (and other full-time instructors) was hired (and remains with us), is paid a competitive salary and given a multi-year, renewable contract.

The proposed policy change became effective during the 2004-05 academic year. At that time we had 35 regular faculty members, 933 majors, taught about 27,000 credit hours each academic year, and as noted had mean TEQ ratings of 4.1 on a one to five scale. We currently have 34 regular faculty members, 1200 majors, teach 31,000 credit hours a year and the most recent mean TEQ ratings were 4.3 on the one to five scale. We were able to reduce overall teaching load and accommodate more undergraduate students by creating new mid-sized (~100 students) courses at the sophomore and junior levels, while maintaining senior level courses at about 25 students, and requiring all faculty to teach at the undergraduate level; the only exceptions are for faculty who cover 100% of their salary from grants. The change in teaching policy has not come at a cost to undergraduate education.

2. Add a grant-writer to the staff. This individual will support grant preparation activities of the faculty and the pre-award activities of the current staff. These additional support activities will enhance the department's ability to manage our current external grants and substantively facilitate the ability to apply for and thus compete for additional external funds. The department will use facilities and administration funds that are returned to the department to support the salary of this individual. We were able to make this hire in the 2003-04 academic year and she remains with the department.

2005	2006	2007	2008	2009	2010	2011*
32	39	37	44	45	51	50

Figure 1: External Grant Submissions

2005	2006	2007	2008			2009	2010	2011*
$1.6	2.3		2.7	3.5	1.7	2.7	2.7	

Figure 2: External Annual Grant Dollars

Figure 1 shows the trend for external grant submissions from 2005 to 2011 (the latter is an estimate based on submissions through June 30, 2011), inclusive. There is clearly an upward trend in the number of grants faculty submit each year – making the process less burdensome on the faculty appears to result in more applications for external grants. The funding situation, of course, fluctuates especially with overall national funding for the National Institutes of Health and the National Science Foundation, the two primary sources of funding for Department of Psychological Sciences faculty. Figure 2 shows annual grant dollars from external grants during this same time period. The value for 2011 is an estimate based on funds from January 1, 2011 to June 30, 2011 and does not include two new hires that will be transferring grants to the Department. In any case, despite a difficult funding climate the Department was maintained and even increased it external funding.

The 2010 NRC ranking provided an opportunity to assess whether we have made progress toward achieving our top 25 goal. It is difficult to directly compare the 1995 and 2010 rankings, because the former provided a single rank and the latter a rank range. Moreover, the number of programs evaluated in psychology increased from about 180 to about 230. Nonetheless, using the lower value of the ranges, the Department of Psychological Sciences was ranked 41 on reputation and 29 in faculty productivity. As a comparison, the Psychology Department at the University of Texas-Austin (highest in Big 12) was 26 on reputation and 27 in faculty productivity. We seem to have gained some ground.

Before completing my term as chair, we proposed development of a state-of-the-art Brain Imaging Center (BIC): Brain imaging research is becoming an integral component in many disciplines in the social and behavioral sciences. The Provost for Research, Dean of the College of Arts and Science, and other administrators were supportive of this initiative and took a gamble. Using facility and administration savings, the university loaned the Department ~$3.8 million to build the center. The Department

agreed to contribute a portion of its facilities and administration returns to repayment, along with BIC income. The Department also agreed to prioritize new hires doing brain imaging research (we have since hired three such faculty). With assistance from the Dean and Chancellor, we secured a $1.2 million private endowment and a $1.2 million match from the University of Missouri System for the endowed Miller Family Chair of Cognitive Neuroscience to direct the BIC. We opened the center 2 years ago and recently filled this chair (hired the director of the BIC from the University of Oregon). It is too soon to know if the BIC will be a success and further enhance the research capacity and reputation of the Department of Psychological Sciences, but the prospects seem good.

In all, the gist is that there are university policies that can increase incentives for faculty members to seek external funding and incentives for departments to change their workload and governing policies to further support these activities. With diminishing State support, limitations on how much tuition can be increased, and stiffer competition for federal research grants, developing and maintaining strong departments in the social and behavioral sciences will require some creativity and risk taking, with the Department of Psychological Sciences being one example of this at the University of Missouri.

The Nexus of Scientific Integration with Behavioral and Social Sciences

Sharron Quisenberry, Vice President for Research and Economic Development, Iowa State University

Iowa State University has a commitment to solving societal problems and improving people's lives. Globally, boundaries are becoming less defined which presents opportunities for solving these challenges. The university believes that the knowledge required to improve quality of life and to face the most important challenges of society can only be solved through the integration of science and creative inquiry – social and behavioral sciences. We believe the university's research enterprise can have a tremendous impact on resolving these challenges based on our tradition of excellence in the life and agricultural sciences, the arts and design, the social and human sciences, and engineering, and given the major societal challenges—food, the environment, energy, and health.

The decisions and action steps that are necessary to solve these challenges will not be determined using quantified information from scientific discovery alone. The decisions and processes are better understood if resolved in the form of social action. This is the result of a negotiated social contract that is grounded on both quantitative and qualitative considerations responding to individual and collective needs of different groups that comprise communities – in other words, solving problems at the nexus of scientific integration with the behavioral and social sciences. Indeed, the National Academies of Science calls for the "New Biology" or scientific integration to provide a deeper understanding of biological systems for biology-based solutions to societal problems, but falls short of including in the equation the integration of behavioral and social sciences.

In a recent strategic planning process, the university developed and implemented a research enterprise plan that balances the multiple goals of the institution while taking into consideration public and private interests. Research focus areas identified are as follows:

- Quality of Life – integration of behavioral and social sciences with the other research focus areas
- Integrated, Innovative Health - health, food, nutrition, and safety
- Biorenewables – products and energy
- New Technologies - materials to systems
- Environment – climate change and ecosystem degradation

These specific research focus areas take advantage of existing university faculty and program strengths. There is a wealth of opportunities for individuals willing to work and network across disciplines and programs. Faculty are encouraged and rewarded for working across disciplinary lines. The solution of complex problems needs a diversified approach or contributions from multiple disciplines and thus, must be promoted from a transdisciplinary scholarship perspective. A diversified intellectual capital portfolio—including humanities, the arts, design, and social sciences, in addition to the life and physical sciences and engineering—will in fact facilitate the development of a university-wide research innovation ecosystem. The resulting programs will form creative catalysts "merging emotive and pragmatic explorations" that lead to visionary planning which promotes growth and impacts and results in generation of income, enhanced technology transfer, creation of value, and program excellence. This approach will also allow us to study the past, to imagine the future, and to synthesize the constantly changing technology, viewpoints, and culture through creative inquiry – the behavioral and social sciences.

Adopting a "New Biology" or "Grand Challenge" approach for the research enterprise will enhance our ability to target faculty hires and leverage resources in strategic areas. By daring to be different and using a transformational systems approach for the research enterprise, we are able to prioritize and integrate our research activities and thus, better able to set achievable and targeted goals and metrics that meet societal challenges and public/private interests. For example, the world's human population is expected to increase from 6 to 9 billion in the next 40 years. This growth will increase food demand from arable land that is nearly completely utilized, understanding that nearly two-thirds of the current global population is either undernourished or obese. These existing global inequities in nutritional adequacy and access to food will continue to be exacerbated and accelerate exponentially in the very near future. Global climate change will also contribute to this problem by changing agricultural productivity and disease incidence and altering the distribution of plants, animals, and humans. This will alter and threaten global food production and, in general, the quality of life globally. Unequal resource distribution will contribute to increases in population densities and political unrest in countries. Thus, a new research approach is needed that recognizes the critical role of humans, governments, and organizations in changing behavior and in being open to adopting new practices that better balance global concerns while targeting environmental sustainability and improvement of health and well-being in plants, animals, and humans. "Such an approach will require fully integrated perspectives from the physical, natural, and social sciences. In particular, there is a compelling need to reshape how scientists think about the impacts of their research on global problems and to explicitly focus on the economic and social aspects of knowledge transfer to facilitate effective adoption of new knowledge." To enhance this concept a step further, we are constantly bombarded by con-

cerns associated with the impacts that nutrition-related degeneration and infectious diseases in populations (e.g., plants, animals, humans) will have on costs, disparities in treatment and prevention strategies, appropriate nutrition within populations, and the emergence of infectious diseases. Concerns are even greater elsewhere in the world where infrastructure does not yet exist for food security and the effective treatment and prevention of disease. The development of effective strategies that ameliorate, mitigate, or prevent nutrition-related degeneration and the occurrence of disease caused by infectious diseases has the potential to change the ability to deal with these challenges. Working at the intersection of biology, engineering, physical sciences, and behavioral and social sciences, the university has a basic foundation of talented faculty and research accomplishments to build successful food security, nutrition, and infectious disease portfolios at the interface between plant, animal, human, and environmental health.

Iowa State University has significant transdisciplinary research strengths that can be integrated to create a unifying and systems-wide vision for resolving society-related challenges such as health, energy, food, and environment. This vision will be achieved by creating a seamless research program that spans basic, applied, and translational research and exploiting synergies among the life sciences, the physical sciences, engineering, and the social and behavioral sciences to create platform technologies and solutions for the significant challenges facing society.

Advancing the Social Sciences through Interdisciplinary Collaborations

Robert Duncan, Vice Chancellor for Research, University of Missouri

Rapid advances in virtually all other disciplines today are being propelled by inter-disciplinary collaborations. I will give some specific examples of successful collaborations in this category at MU. Moreover, I would like to emphasize the important advances that have occurred recently throughout the world through close collaborations between economists and physicists. This has resulted in a new sub-discipline called 'econophysics', which I discuss within the enclosed paper titled "Innovators, Regulators, and the Fate of Nations". In my opinion, this collaboration that has led to establishing 'econophysics' is of great value to society today, and that the proper understanding of risks in the marketplace is essential to the world's recovery from the current 'Great Recession'.

Collaborative Examples

Case 1: Understanding perfect autobiographical memory: A collaboration between psychologists, neurologists, and brain imaging scientists:

About 20 people have been identified with perfect autobiographical memory. An understanding of the underlying reasons for this exceptional ability may prove useful, even revolutionary, in the study of how brain structure and dynamics influences human capability, and in how emotional stability is influenced, if at all, by the ability of people to forget prior experiences. The lead researcher in this emerging sub-discipline of study is Prof. James McGaugh of UC, Irvine. This has been featured on CBS 60 Minutes: http://www.cbsnews.com/stories/2010/12/16/60minutes/main7156877.shtml

Functional MRI brain imaging has shown that all known subjects with perfect autobiographical memory share certain unusual neurological traits: First, they all have a very large frontal lobe, which is no surprise, since the frontal lobe of the brain is associated with memory. Secondly, and less intuitively, these people have a very large caudate nucleus, which exists deep inside the brain. A large caudate nucleus has been associated with obsessive compulsive disorders, and in fact this behavior trait is observed to some degree in most of the subjects. Surprisingly, there is no clear correlation with emotional instability in these subjects. This is surprising since it has been thought that the ability to forget is an essential aspect of human emotional stability. Just the opposite is seen in these people with perfect autobiographical memory. They all have perfect recall of every event during their lives, and some even exhibit a strong emotional response when they are asked about traumatic events earlier in their lives, but there appears to be no strong

correlation with emotional instabilities within this small cohort.

While the reason for the development of perfect autobiographical memory is unknown at this time, it will likely be elucidated over the next few years of focused, inter-disciplinary research. Hypothetically, it appears that those with this trait may have an abundance of adrenaline present in their brains in a nearly continuous fashion. Most of us remember specific events because they are very traumatic, either in a positive or a negative way, and this trauma induces a surge of adrenaline immediately following the memorable event. It is thought that this surge in adrenaline may be precisely what causes the event that triggered the surge to be remembered in the long term. But again, this is a new sub-discipline that will motivate and challenge memory research, and other areas of neural psychology, for decades to come.

This emerging collaborative sub-discipline is a good example of how new technology is able to contribute to a well-established discipline, in this case psychology. This new technology provides an opportunity to challenge long-held beliefs with new data, resulting in a rapid expansion of the conventional discipline. The discovery of these exceptionally capable people with perfect autobiographical memories enriches and enhances our understanding of our neutral diversity, and provides a new approach to understanding the natural wide scope of variations in the human condition. In turn, applications such as this provide new opportunities to advance functional brain imaging, not only through fMRI, but also through other functional brain imaging modalities such as Positron Emission Tomography (PET) and Magneto-encephlographic Imaging (MEG) technologies. The structural and dynamic patterns that these brain imaging systems are optimized to detect depend, of course, on the nature of these patterns themselves, so advances in the understanding of neuroscience feed-back into improvements in the ability of available measurement technologies to detect the new structures and patterns of interest.

Case 2: Nuclear activation analysis and the MU Archaeometry Program. A collaboration between archeologists, anthropologists, and nuclear scientists and engineers:

The MU Research Reactor Archaeometry Program analyzes many different artifacts from ancient indigenous populations. This powerful new technique can provide a valuable new source of data to test earlier thoughts, hypotheses, and assumptions regarding the movements of ancient populations, such as those for which there is only a limited record of their society and traditions. These techniques have helped determine, for example, not only which volcano produced the obsidian that was used to produce tools and weapons of the ancient civilization, but also which eruption of that volcano produce the lava flow that led to the obsidian. This helps reconstruct trade routes of ancient populations, and provides a deeper understanding of their mobility and their level of interactions with other civilizations. This vastly changes our understanding of how ancient civilizations interacted, traded, and moved nomadically. The MU Archaeometry Program has

analyzed over 100,000+ samples, as shown in the following graphic that may be found with much more detail at: http://archaeometry.missouri.edu

Many other technologies have been developed to advance our understanding of ancient civilizations and how they interacted. The MU Archaeometry Program also used state-of-the art mass spectroscopy to perform stable isotope ratio analysis, and trace analysis, to supplement their inferences from trace nuclear activation analysis. These capabilities are strongly enabled by the large interdisciplinary activities at the MU Research Reactor (MURR), which employs over 160 people to staff a wide variety of activities. Furthermore, anthropologists throughout the world have availed themselves of advanced genetic sequencing technology that has been used to perform in depth analysis of the genetic variation and commonality of populations, which provides a powerful tool in discerning how early populations evolved and adapted to their environments, and how they evolved to produce future populations and societies.

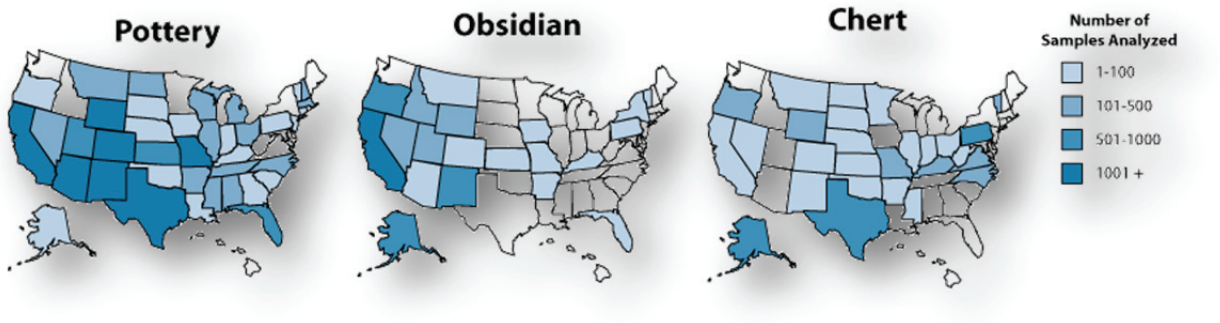

Figure 1: The number of samples analyzed by the MU Archaeometry Program. More details are available at: http://archaeometry.missouri.edu

Case 3: Applications of Complexity Theory to the Social Sciences, especially in the systematic development of 'Econophysics':

The application of scaling and self-organized criticality (SOC) to the social sciences appears to be a rich area for interdisciplinary collaborations. Recently the Joint Chiefs of the US Department of Defense have added a new Special Advisor position for Complexity Research. While the applications of complexity theory have become somewhat of a trendy 'buzz-word' lately, none-the-less the development of complexity theory has been remarkably systematic, and its applications to the social sciences are profoundly enabling of our abilities to understand much more deeply the true nature of risk and benefit in these systems.

One profoundly successful application of complexity theory to the social sciences centered on the development of 'econophysics' by research groups at the Santa Fe Institute (Doyne Farmer), and at Boston University (Eugene Stanley). Many other groups throughout the world have joined this effort, and as early as 2004 the National Science Foundation, through their Consortium of the Americas for Interdisciplinary Science, sponsored a conference in SOC and its

applications to the social sciences in Brazil. There is a high likelihood that many of the social sciences will realize a surge in capability through the application of modern complexity theory within their disciplines.

I have prepared a paper entitled "Innovators, Regulators, and the Fate of Nations" that centered around how profoundly and counter-intuitively the development of econophysics has altered our understanding of the risk – benefit analysis that we perform, often inadvertently, in our everyday decision making. I posit that our misinterpretation of the likelihood of huge, catastrophic events has caused us to go out-of-balance in our applications of regulations and our encouragement of innovation, and that this has damaged society profoundly, and will likely continue to do so in the future. I prepared this paper as an after-dinner talk that I delivered on November 15, 2010, and I have slightly revised it to the form that appears in the Appendix to this paper. I intend to detail this concept in the future, and prepare a monograph on this topic when time permits.

Conclusions

I have discussed the advancement of the social sciences through a few focused examples below. The social sciences, like almost all other disciplines, will benefit profoundly from the new and creative thought, and the expansion of the scientific method rigorously, as technologies are developed to rapidly advance their cause. Of course there are opportunities as well for great advancements purely within each of the social sciences, but in this paper I have restricted myself to discuss collaborative, inter-disciplinary opportunities.

The advancement of all of our disciplines will depend largely on the expansion of resources available for our professional pursuits, and this in turn will require society to see and understand an expanding relevance of our work to the betterment of humanity. In my experience, fresh approaches that become ever more demanding on data-based inferences, and on the systematic development of knowledge through the Scientific Method, most rapidly prove this worth to society, and hence win their support. Such opportunities are also thrilling intellectually, since they almost always lead to unexpected discovery, and the elucidation of systems and processes that were at best poorly understood before. It is this spirit of discovery, coupled with the broader relevance of our work in the social sciences, which promises to reverse the current negative opinion trends, and provide a healthy advancement of these social science disciplines for many decades to come.

Appendix: Excerpts from "Innovators, Regulators, and the Fate of Nations"

R. V. Duncan, Ph.D., Vice Chancellor for Research, *University of Missouri, Columbia, MO 65211*

Why do mighty institutions fail? A related question, centered on how mighty corporations fail, has been addressed in a very competent manner recently by Jim Collins in his book titled How the Mighty Fall. These common causes are not 'scale invariant'. The collection of reasons for the failure of a single proprietor firm is considerably different than the collection of underlying reasons for the failure of hundred-billion dollar international corporations, although there do appear to be a few haunting similarities in these root-causes that may be associated with the personal traits of bravado, arrogance, and denial becoming manifest at a corporate 'group think' scale. But now let's examine even larger scales, and address concerns that are so horrific that they generally go unspoken: Why do nations fail? Why do once thriving societies and their social philosophies suddenly disappear from the face of the earth? Are there underlying root causes that are either ubiquitous in the human condition, or, at the very least, manifest in universal emergent social behaviors? Let's transcend obvious statements like 'corporations fail for lack of proper cash flow', or 'governments fail when they lose the public's trust', since these statements, while true, do little more than acknowledge the obvious. Instead, let's ask what aspects of our nature, and what universal logical errors in our reasoning, so often set us collectively as societies on what, without intervention, will lead to disaster.

Here I would like to suggest that these huge failures in nations occur because we enforce stiflingly rigid regulations where we should innovate, while simultaneously we innovate wildly where any practical, pragmatic society would insist on regulation instead. I propose that it is the wise balancing between regulation and innovation in any society that will determine if it continues to grow strong, or if it fails. I will give a few specific examples from history, and provide some non-mathematical insight into an underlying new scientific concept that has altered our fundamental understanding of risk management profoundly.

First, why would 'hard-wired' physicists try to address a question that would appear to be more appropriately fielded by our accomplished social scientists? Well, many mathematical physicists have been on this intellectual course for about three decades now, in the exploration of what is generally called 'complexity theory' which includes the recently popularized 'chaos theory'. Complexity theory has accomplished at least two intellectual triumphs recently, in my opinion, namely the application of the Renormalization Group Theory to critical phenomena, which won Kenneth Wilson the 1980 Nobel Prize in Physics (which incidentally was the last Nobel Prize to be awarded unshared to a single physicist), and the pivotal development of the theory of Self-Organized Criticality (SOC) by Per Bak in 1988. These are also central to my

own areas of research, at a more humble level. Per Bak was a friend of mine, and a physicist who worked through his joint appointments at the University of Copenhagen and the Santa Fe Institute, and who sadly died at a young age. His work was so interesting and controversial that some of the more conventional physicists I know had hoped that SOC would die with him. But just the opposite has happened. SOC has eloquently resolved difficult-to-understand phenomena that have baffled physicists who study statistical process for centuries. The strange universal relationships between the size and frequency of almost everything, ranging from forest fires, earthquakes, hurricanes, even noise in electronic circuits, to name a few, have led to profound, unprecedented successes in how we accurately understand statistical inference in almost everything we do and encounter. A detailed description of SOC is off-topic for this essay, so I will refer those who are interested to Per Bak's book for the non-specialist entitled How Nature Works (Copernicus, 1996). For those who may want a more mathematical treatment of this theory, please see Henrik Jensen's book entitled Self Organized Criticality, which I have taught interdisciplinary graduate courses from in the past. You may have heard of the popular book by Thomas Bass called The Predictors on this same subject. Bass' book, in my opinion, misses the intellectual essence of this thought revolution, since actually chaos theory predicts nothing about any particular individual outcome at all. In the context of this essay, I will discuss one profound application of SOC below that has become known as 'Econophysics', which has been pioneered by Professor Eugene Stanley of Boston University.

Econophysics has elucidated misconceptions in financial risk analysis that have cost investors literally billions of dollars in the past two decades alone. Sadly, these misconceptions created an industry of high-tech arbitrage hedge funds that have contributed wildly to the demise of our financial markets today. While I wish that I could say this new knowledge has put these dangerous practices out of business once and for all, that does not appear to be the case. Despite the recent near collapse of our financial markets, these option-based funds are reemerging today, with the same crazed persistence and defiance of reality that led initially to support for what I consider to be irresponsible mortgage lending recently within the American Recovery and Reinvestment

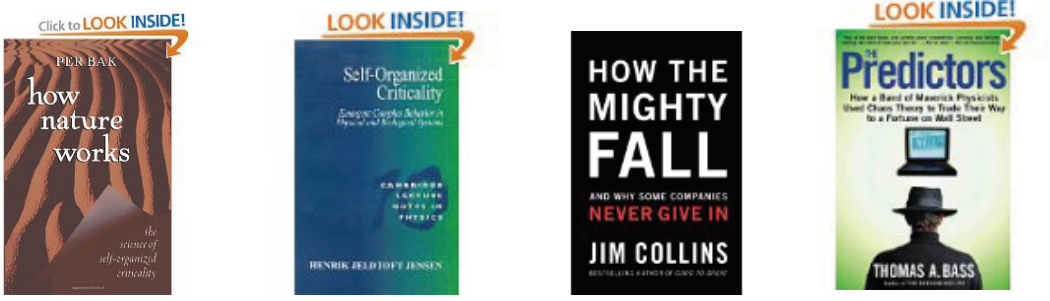

Figure 1: The four books that are referenced in this essay. All are readily available on-line.

Act. Whether it is the unrealistic desire to get rich without producing any real value to society, or the determination of well-meaning politicians to create unattainable home ownership for everyone in the United Sates regardless of their level of income or demonstrated personal responsibility, compelling ideas persist that defy respect for the statistical variance across our populations, and which fly in the face of economic reality. This becomes a superb illustration of the first of two ubiquitous reasons why nations meet their ruin: They innovate wildly in situations where any reasonable value system would properly insist on regulation instead.

In 1994, two prominent Nobel Laureates in economics, named Robert Merton and Myron Scholes, joined with a legendary bond trader named John Meriwether to form a company called Long-Term Capital Management L.P., and they rapidly accumulated five billion dollars in operating assets for their company. They promised huge returns at effectively no risk, based upon their mathematical model of market fluctuations. We now realize from our new understanding of econophysics that this model was dangerously naïve. Long-Term Capital Management practiced fixed-income arbitrage trading, where they identified essentially identical assets that were selling at different prices in different market locations around the world. They would sell the more expensive asset short, while buying a long position on the undervalued asset. In so doing they were positioned to make substantial income without regard for the increase or decrease of the assets' price, just as long as the cost of the nearly identical assets converged over time. Indeed, for their first four years they made an outstanding return, in excess of 40% per year. But suddenly in 1998 they lost over half of their assets, and ended operations with a huge loss in 2000. The business community found this shocking, the physicists found it fascinating, and the founders of the company claimed that they had experienced a market fluctuation of the likes of which should only have occurred once in 70,000 years! What was their big mistake? Well, they had assumed that the fluctuations of the markets could be described by a 'Gaussian' statistical distribution mathematically, which would have been correct only if all stock and commodity traders functioned as entirely independent actors on the world's financial stage. But that is certainly not how traders operate. Instead they follow each other's leads spontaneously and so tightly that the leader often at the time has no idea that he or she is actually leading! These tightly oriented trading relationships occur at all scales from big to small, and they dynamically redefine themselves in absolutely unpredictable ways, creating an operational definition of chaos. Traders follow each other's leads much in the same way as birds flock or bees swarm. Modern electronic trading modalities further lock trading strategies together in complex ways that the individual investors themselves don't understand. This is clearly not consistent with the independent trader model that is at the basis of a Gaussian distribution of market fluctuations, and which was at the heart of classical financial stability theory until the late 1990s.

In a nutshell, the problem with Long-Term Capital Management L.P. was that all classical financial stability theory up until 1998 was based implicitly upon these 'independent trader' models, which resulted in Gaussian statistical distributions that attempted to predict the probability of market fluctuations. Conceptually, without jumping deeply into the mathematics, correlated trades vastly increase the risk of catastrophic failure, but it is uncanny that much smaller fluctuations that happen often are none-the-less well described by conventional Gaussian distributions. Only about two in a hundred fluctuations are expected to be larger than two standard deviations from the mean according to Gaussian statistics, and this is true in highly correlated markets as well. So, if your comparison of your risk model to actual observed market fluctuations only consider common fluctuations, and never tries to understand the really rare large ones, then you will be misled into thinking that the Gaussian distribution works well, just as the Nobel Laureates in Long-Term Capital Management L.P. did. But in highly correlated markets the probability of very rare market fluctuations, such as fluctuations that fall more than three standard deviations from the mean, are vastly more common than a Gaussian distribution would suggest. Highly correlated trades produce large fluctuations that are governed by power law distributions called Levy distributions, and these fall off toward zero probability much more slowly than does the Gaussian distribution. I like the following analogy: If buffalo stampeded independently, that is if they ran around at a gallop while they completely ignored each other, then there would be a Gaussian probability that occasionally a few less competent buffalo would not see the cliff in time to avoid charging off it, but by and large the heard would not be at any catastrophic risk of extinction due to the cliff. But in real life, stampedes are highly correlated, with buffalos blindly following each other's leads in rapidly changing, chaotic ways. If the inadvertent lead buffalo charges off the cliff accidentally, then there is a good chance that the entire heard will do the same, creating a catastrophic event that could end the existence of the entire herd.

In order to understand the true fluctuation distributions in financial markets, Eugene Stanley obtained the time series of over 1.5 million fluctuations in the Standard and Poor's financial index to develop a probability distribution of market fluctuations over various time scales. He has subsequently done similar analyses of other market indices throughout the world, and for individual stocks in particular markets. The generalized probability distribution that he observed in the S&P index fluctuations is displayed in the figure below. Notice that fluctuations within two or three standard deviations from the mean are well modeled by a Gaussian distribution, but that much larger fluctuations are far more common than a Gaussian distribution would predict. When this sort of analysis was applied to the Meriwether hedge fund's operation, their 'once in 70,000 year' fluctuation, as inappropriately modeled with a Gaussian distribution, would have been expected to occur in less than five years, and in fact it did. Many people lost some or all

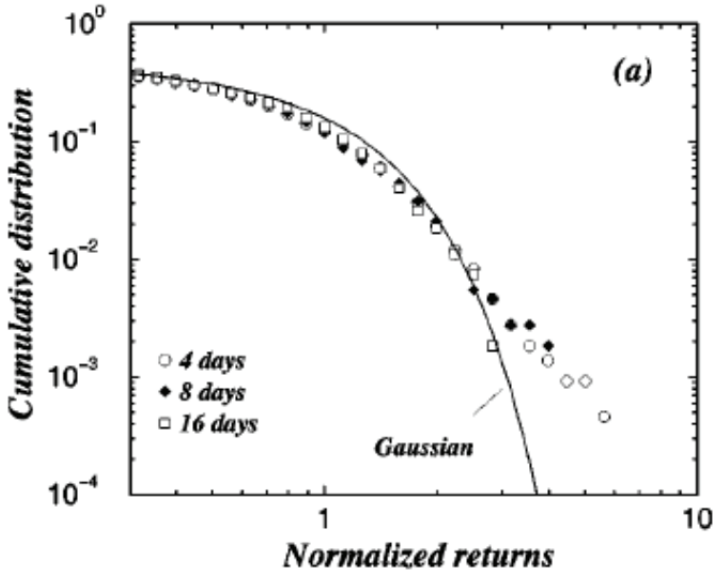

Figure 2: Data on the observed fluctuation probability of the S&P index, using over one million observed fluctuations of the actual index on various time scales. From "Scaling of the distribution of fluctuations of financial market indices", by Parameswaran Gopikrishnan, Vasiliki Plerou, Luı´s A. Nunes Amaral, Martin Meyer, and H. Eugene Stanley (Physical Review E 60, 5305 (1999). Notice that the probability of a fluctuation occurring at two standard deviations from the mean (approximately normalized returns = 2) is about one in 19, in good agreement with the Gaussian prediction. The probability of a fluctuation that is three standard deviations from the mean is predicted to occur about once in 225 per the Gaussian distribution, which agrees fairly well with reality. But the probability of a fluctuation at six standard deviations from the mean is predicted to be one in 165 million per the Gaussian distribution, while this actual S&P analysis suggests it will happen far more frequently, at about one time in 2,000. Hence, the probability of huge 'catastrophic' fluctuations is vastly larger in highly correlated systems such as market trading than a Gaussian distribution would predict.

of their retirement accounts and their life savings as a result of this big philosophical and hence mathematical misunderstanding. While I was the Gordon and Betty Moore Distinguished Scholar at Caltech in 2004 I was working with some of the world's leading physicists as we successfully applied SOC to understand anomalous heat transport near the superfluid transition in helium. Two years earlier, one of the brightest students I know from Caltech completed his Ph.D. under the advisement of a theoretical physics professor with whom I have collaborated for many years. This student was hired by a very wealthy firm in New York City to apply many of these econophysics-related techniques to properly price derivative trades based upon what had been learned following the gruesome 1998 failure described above. With the advent of very sophisticated electronic trading since that time, as well as new, wildly complex arbitrage fund strategies, theoretical techniques based on econophysics predict an absolute instability that results from an infinite standard deviation in the realistic probability function for market fluctuations. None-the-less, by the time that the economies of the United States, and in fact the economies of most of the world, nearly failed in 2008, economists estimated that over 20 trillion dollars of so-called market value was tied up in derivative financial instruments, including options! Please realize that most of this 20 trillion dollars was associated only with the value of option bets, and hence, was in no way associated with any real production of goods or services. Sadly, it appears that we did not learn anything from the terrible failure of Long-Term Capital Management L.P. a decade earli-

er! Worse yet, a substantial portion of our perceived market rebound today is actually associated with growth in arbitrage fund values, and hence in new and more sophisticated option-based instruments. Regardless of how you dress up an option, it is still nothing more than a bet. Options were invented honestly enough as a hedge against risk, but they went malignant, and they now threaten the survival of our markets. Computers can generate thousands of these option-based bets per second, and each can be assigned a cash value, now using these complex tools that we have learned using econophysics. As the economy expands again, people are actually buying option-based securities for retirement accounts and other funds that they manage. This is a simple example of improper value being generated from vapor, and it threatens to continue to produce an ever increasing cascade of disasters in our economy until all financial systems throughout the world are left in ruin.

Why do we permit such wild innovation from some of our best mathematical minds of our time in our financial markets, where any sane system would require regulation instead to protect the accumulated value of our citizen's life savings and retirement accounts? By and large these option trades do not help produce and trade goods and services, which is what we established financial markets to do in the first place. They simply are bets. Why aren't these outstanding intellects joining with others who are currently striving to cure cancer, to solve the world's energy problems, and in other essential pursuits? I am not opposed to honest option trading, but let's be realistic and not consider them in any way to be securities. Imagine how much healthier we would be if we honestly treated options as bets, and only permitted them to be sold in a manner that is consistent with gaming laws in states where gambling is both regulated and legal. This would also emphasize that our markets are to be used in a manner that is consistent with the growth of a healthy economy, and not as a playground for sophisticated tricksters to try to squeeze money out of inefficiencies in the mechanics of the trading operations. This, and proper financial management of margin trading accounts, could prevent future market crashes that very likely will be far more severe than those that we have experienced already. Proper regulation of these options would put our best minds back to work on innovations that create value for society and improve the human condition overall.

Unfortunately, it is all too easy to find examples of the second component that I posit threatens national survival, namely that we inappropriately impose daunting regulations in situations that suppress real creativity, when actually we should encourage innovation instead. Just look at modern research universities across the United States today. These centers that are dedicated to the advancement of knowledge are persistently being scrutinized through public regulations to assure that no value that they may someday create is in anyway developed in such a manner that it unfairly benefits one group over another. The rate at which new regulations are being heaped on everything from conflict of interest rules to export restrictions, and everything in between, is

staggering, and these practices are vastly slowing the rate at which our knowledge-based economy can recover today. Please understand that I am all in favor of proper operations of university research and intellectual property commercialization, but I suspect that the extreme emphasis and expense associated with policing these essential university functions is inconsistent with a rational, evidence-based assignment of resources in academia today. I estimate that only about 0.2% of all federal funds to universities are misappropriated, on the basis that this is about equal to the disallowed charges that are returned by universities to the federal government as a result of audit findings. I would suggest that a little less federal regulation of university research, and a little more federal regulation of the options markets discussed above, could have saved humanity a lot of lost value during the financial failures that started in October of 2008. We at MU have tracked how much effort we have had to spend on new unfunded mandates on research over the last two years, since new regulations on research, many of which are associated with the American Recovery and Reinvestment Act (ARRA), went into effect. This has come to about 1,200 hours of effort at MU without any opportunity to recover these labor costs from the government agencies that requires this labor from us. By the way, only 2% of the nearly one trillion dollars that have been spent under the ARRA has been spent on university research, but when the public's displeasure with the results of ARRA surged, the media did nothing but discuss what they considered to be wasteful spending on university research from these funds. This is in part true since it is very easy to wildly simplify new innovations, and thereby make innovators look foolish. If the efforts by universities and businesses to innovate and to produce new value for our economy through discovery continues to be unfairly and disproportionately hounded by federal regulators and by the press, then the reemergence of our former standard of living will be stifled for many years to come.

As C.D. Mote, the outgoing Chancellor of the University of Maryland put it, for every one engineering-ready degree that was awarded in the United States in 2007 there were 25 law degrees and 50 MBAs awarded. Our inattention as a society to the Science, Technology, Engineering and Math (STEM) disciplines has led us to produce regulators from our own citizens at an astounding rate, while producing very few innovators. Hence, predictably, most of the business community in the United States today knows how to regulate well, but is generally losing touch of their knowledge of how to innovate. Of course business and law are very important disciplines, but we have overchecked this box at the expense of our technical creativity. Simply put, we have gone from being a wonderfully successful Nation of innovators to a failing Nation of regulators over the last three generations. The vast majority of our science and engineering students in the United States today are from foreign countries, and our best engineering faculty members at MU are routinely limited on their sensitive, government-funded projects by their inability to attract graduate students who are U.S. Citizens to help them

perform the work. At the same time, this base of international graduate students who matriculate to U.S. universities to advance non-sensitive, basic science is falling off rapidly today, as the U.S. loses its luster as the best place in the world for personal career advancement. This is even more disturbing, since many of the top business and public leaders in the U.S. today had immigrated here for university study. As we lose this luster that has historically attracted the best and brightest students from around the world, we lose our future prosperity.

There is another effect as well: Academia, and innovative companies, attempt to spend their time and resources on innovation, and hence are less prepared to defend themselves against those who seek to assign blame when the public becomes angry over their declining quality of life. Hence those who have to appear to generate a solution that addresses short-term public concerns through regulation are much more likely to disproportionately try to blame the innovators for the failure of society, thereby compounding the problem. These effects conspire to create an environment where real technical innovation and creativity, which is essential to our national recovery, is forced off-shore instead.

I won a major foundation grant a few years ago, which provided me the opportunity to collaborate closely with Academician Alexander Andreev, Vice President of the Russian Academy of Sciences, and hence to travel back and forth to Moscow many times from 1998 to 2004, during which time I learned a lot about the long-enduring conflict between innovators and regulators in Russia. I would like to suggest that it was the failure of the former Soviet Union to innovate at the beginning of the nuclear age that ultimately resulted in the downfall of this nation that was once a formidable superpower. Suffice it to say that when Joseph Stalin backed a recommendation by Lavertiy Beria, then the ruthless head of the Soviet Secret Police, to simply steal and copy U.S. weapon designs, over physicist Piotr Kapitza's urging that they design better weapons instead, the demise of the former Soviet Union was just a matter of time. Hence, during the critical first ten years of the Cold War, we in the United States were quite specifically familiar with the design limitations of the Soviet arsenal, since it was simply copied from us, so we knew precisely what their threat consisted of and how to defeat it. Beria's victory with Stalin over Kapitza's objections, in my opinion, set the Soviet Union on a philosophical course that strongly preferred regulation over innovation, and ultimately resulted in their demise. History is rife with many other examples of how nations have failed due to their refusal to be innovative at critical times in their national progression. Sadly, and in my opinion, the United States is currently on a clear course to suffer a similar fate today.

Figure 3: Beria, the ruthless head of the Soviet Secret Police, Nobel-prize winning physicist and Academician Kapitza, and Soviet Party Chairman Stalin. The details of this classic conflict between Regulator and Innovator are as fascinating as they are horrific.

Fortunately we in the United States are excellent at making major course corrections rapidly, and it is of the utmost importance that we start to do so now. We must stop innovating new methods of trade in our financial markets that serve only to try to extract wealth with no real production of value to society, with no increase in our quality of life, and with no real commercial output of goods and services. Instead, we have to return to a respect for, and a dedication to protect, our wealth management structures in the USA that contain the retirement accounts of our citizens. We must start genuinely innovating new and creative products and services again, against the huge opposition of an expanding federal government that knows almost nothing more than how to put our citizens to work as regulators. Regulators and innovators naturally distrust each other, but now is the time to have both of these essential elements respect each other, with a common focus on increasing real national output. In my opinion, it is of paramount importance for the United States to come back into the proper balance between regulation and innovation as needed to see our wonderful and egalitarian Country, with liberty and justice for all, prosper again, and thereby assure its continuation for centuries to come. The alternative is simply unthinkable.

Building Collaborative Research Teams in the Social and Behavioral Sciences

Chitra Rajan, Associate Vice President for Research, Iowa State University

For the past few years, Iowa State University (ISU) has experienced severe and permanent reductions in state support. The Office for the Vice President for Research and Economic Development (VPR/ED) received its share of budget cuts and had to make some significant changes to accommodate these new economic realities. We considered and adopted a number of structural changes aimed at reducing costs. Vacant positions were not filled, contributions toward faculty start-up and retention offers were reduced, support for centers and institutes was drastically cut, and every possible 'discretionary' expense was eliminated. It should be pointed out that the VPR/ED Office relies heavily on state support, unlike our colleges who get a share of tuition revenues and have far greater fund raising opportunities.

The VPR/ED Office is responsible for many of the research support service centers (contracts and grants, compliance, animal research labs, some central research facilities, etc.) and austerity measures, if taken to an extreme, could seriously impair the university's research capabilities and assets, and harm future developments and growth. The university was very aware of this danger and did its best to protect the VPR/ED Office during these fiscally difficult years; nonetheless, budget cuts were both real and painful.

At the same time, this was a period when many of the prior investments in faculty recruitments and research infrastructures were beginning to pay off: after three years of declines in sponsored funding, the university saw not only an up-turn, but significant growth in research expenditures. Encouraged by these successes, the Office of the VPR/ED decided to continue, and in some cases even increase our support for certain critical areas, despite these difficult times. Increased support for some of the larger centers (those that had an annual research expenditure that produced over $1 million of F&A revenues) came in the form of sharing overhead revenues from grants; the VPR/ED Office negotiated with the Colleges and developed a plan that would return a portion of F&A revenues back to the center so that they could invest those funds in the infrastructure necessary for their research. Such a revenue-sharing funding plan was possible because the university had adopted a decentralized budget plan whereby colleges and vice presidents received a share of the F&A revenues and were responsible for overhead costs. We also made the difficult decision to discontinue support for several centers and institutes (these centers were given the option of moving under a larger institute or into their college) so that we

would have the resources that we needed to re-organize and truly support a smaller number of programs.

One such area was survey and behavioral studies. This is an area where ISU has considerable strength and our faculty have national recognition for their contributions to this area. Prior to the budget cuts, we had two separate centers/institutes that reported to the VPR/ED Office – the Institute for Behavioral Research (ISBR) and the Center for Survey Statistics and Methodology. Although both centers had impressive levels of external funding, the overhead costs were much greater than the indirect revenues that they were able to generate. Both centers had a large number of staff (most of them were paid from grant funds) and so were located at the university's research park, since space for such a large group was not readily available on campus. Consequently, the overhead costs – in terms of the administrative staff required to manage these two large groups and the cost of rent were very high. While both centers recognized that they had complementary and even overlapping skills and strengths, and that some economies of scale could be recognized if they worked together, the time, effort and IT resources that it would take to make that possible appeared to be prohibitive.

After three years of budget cuts, it became apparent that the amount of resources that these two centers received from the VPR/ED Office was no longer sustainable. Yet, it was important that we provided the institutional support that was necessary for research in survey methodology and behavioral sciences. Clearly, the faculty members were able to garner enough grants to cover their direct expenses; it was the overhead costs that had become prohibitive. To address this problem, we had to find a way to reduce the overhead costs. We decided to consolidate the "service" components from both centers to create a new unit – the *Survey and Behavioral Research Services center* (SBRS). This in itself was not particularly interesting; consolidating and merging units are not unusual cost-cutting approaches. The important question was whether the combination of the services from these two centers into one unit could provide ISU faculty with a *greater* level of research support than previously provided by both CSSM and ISBR?

First, the Survey and Behavioral Research Services (SBRS) was created with emphasis on providing services, not as a program or center of excellence. This meant that is primary mission was to serve as many faculty as possible, and once established, it would operate as a fee-for-service unit. If successful, it would attract enough 'business', become self-reliant (or at least, require minimal institutional funds) and therefore unaffected by fluctuations in state support for the university. To underline its service mission, the SBRS would be a unit within the university's *Statistical Laboratory* which was established in 1933 and part of the Statistics Department. The Statistical Laboratory is famous for the high quality statistical consulting that it has provided to ISU faculty since 1933. The Statistics Laboratory has historically specialized in statistical methods for agriculture, biology, and engineering but with less emphasis on methods for the social and behavioral sciences. The creation of

SBRS would now give the Statistics Laboratory a chance to help faculty in this new area. The Statistics Laboratory has always reported to the VPR/ED Office and therefore the SBRS would be under its purview.

Second, the SBRS was created by merging the accounting, IT, and data collection units from the *Institute for Social and Behavioral Research* (ISBR) and the *Center for Survey and Statistical Methodology* (CSSM). To reduce costs, redundant accounting and IT positions from the ISBR/CSSM merger were eliminated; ISBR faculty affiliates were moved back to campus thereby freeing up the need for a large (22,000 sq. ft.) space in the Research Park; and the newly merged SBRS staff were moved to a smaller (7,000 sq. ft.) space in the Research Park. These measures reduced the overhead expenses by 50% and allowed it to offer a new slate of services as described below:

This new unit has the capacity to provide a full set of services to researchers including both proposal development and administration and all modes of data collection services.

Services and Resources

SBRS provides statistical and psychometric statistical consulting for the social and behavioral sciences to supplement the statistical consulting services of the Stat Lab. Examples of statistical methods for the social and behavioral sciences:

- Design of human subjects experiments
- Questionnaire design
- Sampling design
- Program evaluation
- Meta-analysis
- Latent variable structural equation modeling
- Psychometric reliability and validity analyses
- Assistance with SPSS

Research Consultation is available to investigators to assist in defining study objectives, identifying study populations and sample design, developing survey instruments, or evaluating appropriate survey methods. Cost estimates for conducting surveys or collaborating on proposals are supplied upon request.

Research Collaborations are supported for large surveys and projects requiring innovative survey methods. CSSM faculty provides SBRS staff with sampling and statistical methods support for grant proposals and studies using SBRS data collection services.

Grant Proposal Development and Administration Assistance are available to faculty and staff making applications for grant opportunities in all areas of research. Staff is experienced in developing budgets, coordinating proposal development and submitting proposals through the university and federal proposals systems.

Sampling Expertise for SBRS projects is provided by CSSM faculty including Random digit dialing (RDD) samples, list samples, area samples, case-control designs and weighting calculations.

Survey and Questionnaire Design services are provided by professional staff and include designing survey instruments, focus groups scripts, cover letters and training materials.

Data Collection is conducted by SBRS staff in a variety of modes. The staff has experience in a wide range of data collection methods for both one-time and longitudinal surveys, including:

- Computer-assisted telephone interviewing (CATI)
- Computer-assisted personal interviewing (CAPI)
- Observational Video and Audio-recording & coding
- Mail Surveys
- Web Surveys
- Focus Groups

Quality Control is a high priority for SBRS. All research procedures are conducted with the utmost regard for accuracy and confidentiality. Telephone interviews are reviewed on-line through a silent monitoring system to ensure high data quality standards, interviews and resulting data files are edited for accuracy, and double-entry procedures are used in key-entry tasks.

The SBRS is now a year old and its first year proved to exceed all our expectations. The unit helped faculty submit over 30 grant proposals worth about $16 million. We have yet to see how successful these efforts will be. SBRS has 3 years to prove its viability and the associated faculty have been told that they will be assessed based on the following: (a) it has enabled research that was otherwise not possible (and not just diverted research management from other units); (b) impacted a broad group of faculty; and (c) is able to develop a "business model" that makes it fairly independent of institutional support.

One Approach to Establishing a Research Center in Today's University Environment

Dennis Molfese, Mildred Francis Thompson Professor; Director, Center for Brain, Biology, and Behavior, University of Nebraska-Lincoln

Background: In the fall of 2010, the University of Nebraska-Lincoln recruited a senior investigator to build an interdisciplinary brain-imaging center. This recruitment developed from an initial faculty initiative, Systems Biology of Social Behavior (SB2). This initiative was supported by several departments within the College of Arts and Sciences. These included Anthropology, Biological Sciences Political Science, Psychology and Sociology. Core members of that initiative had established a significant track record of funding through NSF and NIH. This interdepartmental initiative quickly gained ground with other departments within the College and caught the attention and support of the University's research administration. The faculty made effective use of the University's internal grants program to secure additional funding support for further organizational work and planning.

In the meantime, the Dean of the College met with the involved faculty and worked with them to identify resources in terms of future faculty lines, space and other support. In addition, a grant proposal was drafted and submitted to NSF's Integrative Graduate Education and Research Traineeship Program (IGERT) involving these departments. Although that proposal received high marks, it was not funded. However, NSF invited one of the lead authors to serve on a review panel for the next grant review cycle for other IGERT applications. The review panel experience provided him with the opportunity to learn more about the grant review process that then helped in revising their earlier application. In addition, the University's Research Office made arrangements for a small panel of external experts to review the revised application before resubmission and provide detailed feedback to the organizers. That feedback proved invaluable and the document was significantly edited in light of those comments and comments provided through the previous review. Subsequently, a revision of the original application was submitted for the next round of applications.

As part of these grant initiatives, faculty from traditional behaviorally-oriented departments requested access to state-of-the-art brain imaging equipment to address non-traditional questions related to their own fields of study. In response to this groundswell of support, the Administration and faculty worked in unison to recruit senior faculty including someone familiar with advanced brain imaging techniques to help build on and develop further this initiative. Today, one year later, an officially

designated "Center for Brain, Biology and Behavior," exists that houses two different functioning brain imaging systems (high-density EEG, NIR) with a third type (fMRI) on order. The first two systems are now being used to train interested faculty and students while others who have completed their training are using these systems to conduct experiments. In addition, ground was broken last spring to erect a building with 24,500 square feet set aside to house the Center, the brain imaging equipment, a series of dedicated and communal laboratories and its interdisciplinary faculty. The building was part of a football stadium expansion project that added additional reserved boxes for revenues. Following initial discussions on the incidence and management of concussions in athletes, the Athletics Department proposed that a portion of that building be set aside for the research Center.

Administrative Support. The Administration, of course, controls and oversees the distribution of University resources. In this era of continuing cutbacks in funding for higher education at the state and local levels and the sharp reduction in monies available to federal grants and contracts, the management of increasingly scarce resources has become even more critical. Decisions must be made in part on the basis of which priorities are more likely to best advance the aims (if not the survival) of the institution. In the case of the University of Nebraska-Lincoln, the Administration recognized the benefits of the faculty initiative and decided to focus on it as one of its major priorities for the year. This involved the commitment of the A&S College Dean, upper administration and individual departments to identify additional faculty lines, monies to cover salaries, recruitment packages, and the space to house such an endeavor. At the same time, working together they developed a set of goals that they used in part in discussions with faculty as well as part of their evaluations of potential candidates to lead the Center initiative.

Faculty Support. Faculty support is essential to the success of any large-scale initiative within the University. Faculty and their students must support the initiative not only verbally but must be willing to commit their own time and energy to pursuing the goals of the initiative. They also must both recognize that their time commitment will be significant and be willing to invest their own energies in pursuit of activities that utilize and advance Center objectives. This is not a trivial commitment. These faculty and students are already pursuing their own research and training interests that first brought them to the University. Now they must commit hours of their time to learning to use new technologies and methods as well as a research literature that uses a different vocabulary and concepts from what they previously experienced. At the same time, of course, Center objectives must also be congruent with faculty interests and goals. In our case, the faculty and Administration had already begun to develop a shared vision as part of the SB^2 initiative. The vision was in no way complete but was continuing to develop. At some point it became clear that they needed someone who could dedicate more time to organize and advance the vision. At that point they began an external search for a Center Director.

The Evolution of the Center and the Center Director Position. Initially, the University was not seeking to establish a Center nor looking for a Center Director. Instead, the Chancellor had called on the faculty to identify senior, productive researchers who might be recruited to strengthen the University's research productivity and grant success. Because of the interdisciplinary interest in the SB² initiative, one nominated scientist came under more intense scrutiny and was invited to interview as a potential addition to this interdisciplinary effort. However, as discussions progressed between the candidate and the A&S Dean as well as the Vice Chancellor for Research and Economic Development, a vision of other possibilities began to emerge. The Dean of A&S and the Vice Chancellor for Research asked for a business plan to organize and articulate the candidate's vision for further developing the SB² initiative. Given that both the SB² faculty and the candidate were interested in utilizing a range of neuroimaging tools to study the relationship between brain and behavior, the candidate developed a 10-page business plan that reviewed the SB² initiative and made recommendations about the kinds of facilities and equipment that would be needed to advance that initiative. This plan included cost-benefit estimates on whether to pay fees to access current brain imaging systems in the region or to obtain new and dedicated systems that would provide more ready access to faculty and students. Costs and benefits were estimated in terms of immediate access, travel time, and costs per use vs. the use of grant submissions to obtain such equipment vs. the outright purchase of equipment. Estimates were also provided concerning the types of essential staff needed for such an undertaking as well as their costs. A voucher plan was also proposed that would enable non-funded investigators to obtain small grants to pay for fMRI time while they developed their expertise and the publications and pilot data necessary to support their NIH grant applications. During this process the Vice Chancellor and other administrators began to consider committing significant resources to fund such a business plan.

In addition, both administrators and faculty asked questions concerning how one would engage faculty with no prior experience in brain research to engage in such an enterprise, what equipment would be important to procure, how such equipment could be obtained, how faculty, graduate and undergraduate students could be trained to use the equipment in a timely and cost-effective fashion, how to secure external and internal funding to support such a Center, what agencies to approach for funding, how best to present such funding requests, who should be associated with such a Center, its administrative structure, space needs, what staff hires would be essential to initiating its operation, the feasibility of and strategies for making such a Center self-supporting, as well as an estimate of when it actually could meet that goal. Within approximately six weeks of the initial interview, plans were emerging for an interdisciplinary Center founded on the SB2 initiative, a Center Director was hired, space was identified to house the Center, and significant funds were committed to purchase an fMRI as well as EEG imag-

ing equipment, supplies and hire support staff.

Elements Critical to the Success of a Center. For a Center to be successfully established and thrive, there are a list of critical elements to be considered, addressed and obtained: (1) sufficient faculty interest, (2) the means to grow additional interest and involvement in the Center from other faculty and students, (3) Administrative interest and support that overlaps faculty interests, (4) the acquisition and maintenance of core facilities including equipment that promote the goals of the Center, (5) the success of common activities to facilitate professional interactions, (6) an effective training program for Center participants in the use of Center equipment and facilities, (7) an automated computer based scheduling program to maximize the effective use of those core facilities, (8) a means to foster not only individual but group collaborative grant development projects to federal and private agencies, and (9) a strong external panel of expert advisors willing to lend their expertise to support the Center's success.

Strategies for Estimating the Startup Costs for Such a Center. The preceding paragraph lists nine key elements that are viewed as critical to developing a successful Center. Negotiations with administration regarding potential startup costs should address some if not all of those points. While not all routinely have a monetary cost, all are important. Without points 1 through 3, the likelihood of success is limited and attempts to start such a Center would be premature. It is easy to focus on point 4 concerning core facilities or equipment. This equipment must be state of the art, user accessible, and have a history of cost-effective and scientifically sound service. In considering equipment, annual maintenance charges must also be factored in as a cost. Consulting with experts in the field can lead to the identification of individual pieces of equipment including models and costs. Inquiries regarding software acquisition and analysis packages widely used in the fields of study, their availability to your Center at cost or at no cost, are critical prior to developing a final list to be submitted to the administration. Training in the use of the equipment, standard test procedures as well as safety procedures are always important and critical factors. If the equipment is not used correctly or abused, the research programs will suffer and time will be lost in costly repairs or wasted test sessions. To maximize usage, training should be available for faculty, postdoctoral fellows, visiting scientists, graduate students as well as undergraduate students. Depending on the complexity of the equipment and procedures, the trainer could also have one or two additional although less time consuming responsibilities. Many Centers found the use of automated scheduling programs to be quite cost effective, maximizing the use of equipment as well as research space. If an investigator cancels a test within a few hours of the scheduled time and alerts the system, an automated call goes out to an ordered list of investigators indicating that equipment and/or space is available within a certain timeframe if they contact the system. If there is not reply, the next individual or group requesting time is then alerted and the sequence repeated. Encouraging collabora-

tive as well as individual grant initiatives is important to the Center's success. A universal dictum is that Centers should at some point become self-supporting through grants and contracts. If a research office is not available to Center personnel through the parent institution, then recruiting research consultants who are expert in institutional grants and contracts will be an additional cost. Even so, numerous Centers over time have developed their own grant submission support staff as a means of providing more direct contact with the grant writers during that process.

Reporting Lines for a Center. Every University has a different approach to this issue. Some institutions such as the University of Missouri, Columbia, maintain an imaging center within a specific department. In their case, this is the Department of Psychology. Other institutions have established stand-alone Centers that are overseen directly by an upper administrative level or are maintained as part of a medical school as is the case at Yale University. Different approaches work well in different environments. Some argue that if the focus of the Center is on a faculty within a College, it is reasonable to keep the reporting lines for the Director of the Center restricted to that Dean, with input from departments that make up the college. On the other hand, if the Center is to have a broader level of involvement across the University, then the Center should be able to draw on guidance from the next level of administration. Given the involvement of different colleges at this level, it might make sense for the College Deans to also play some role in advising the Center. In our particular case, given the broad involvement of so many departments across all the colleges, an administrative decision was made to have the Center Director report directly to the Vice Chancellor for Research and Economic Development. Other University-wide Centers also report to this office as well as the University's research support office.

The Continuing Role of Faculty and Students. At the same time, of course, faculty and students directly involved in Center activities should play a role in Center policy and direction. Routine issues for the Center to address range from space management to recruitment and the use of resources. Faculty groups such as SB2 play important roles, both in helping to define the missions of the Center as well as serving as a successful model for other initiatives whose success depends upon the integration of faculty interests in pursuit of break-through research and training initiatives. An external advisory panel composed of other Center directors as well as prominent scientists should be identified and retained. Yearly meetings of this group provide important guidance to the Center in its mission. These meetings also form the basis for a yearly conference to promote Center accomplishments through the publication of edited books and special journal issues.

Training: For such a Center to develop and thrive, of course, it must not only attract administrative, faculty and student interest but must also train users in a maximally efficient way so as not to disrupt their other professional commitments. Moreover, such training must lead to efficient and effective use of Center resources including the imaging

equipment so that the new users can publish and become competitive in securing external grant support to advance their studies and careers. These are all issues that we are currently addressing. In the brief period between October 1, 2010 and July, 2011, the Center has grown beyond its roots within the College of Arts and Sciences to encompass literally every college within the University. As a result, it has become thoroughly interdisciplinary, including faculty and students from music and art to anthropology, political science, psychology and education. Some 134 faculties along with their graduate and undergraduate students have completed our two-day workshops on methods, theory and applications. An additional 32 individuals are involved in different levels of training in using the advanced imaging equipment to collect data. At this point three different research groups have begun their testing of subjects in their own designed studies with their own testing personnel. All of these trainees are a part of our seven step training program is now in place to train faculty and students in the use of the advanced imaging equipment and procedures.

Seven Training Steps. The training program we adopted was designed to introduce the initiate to the major theoretical, methodological and technical aspects of the field of neuroimaging and cognitive neuroscience in as short a time as possible but also with as much hands on experience as possible. Training involved an initial overview of cognitive neuroscience and brain imaging techniques that are directly related to the interests of the audience who, for the most part, only has conducted investigations into behavior. The ultimate goal of these seven steps is to take the attendees from novice to an informed investigator who can design, conduct, and analyze studies involving the technique and who will then be able to submit conference papers, articles to their professional journals and, eventually, grant submissions to obtain funding to continue support for their work.

To pursue and support such a model, we developed the following seven-step training plan:

1. Interested participants first volunteered to attend a two-day (20 hour) workshop on the history, research questions, methods and technology involved in any of the types of brain imaging methods that we currently have available – fMRI, high-density ERP/EEG, and Near-Infrared Spectroscopy (NIRS).
2. Twenty-five hours of training in the set-up, design and operation of the equipment to obtain the brain imaging data as well as the development of materials needed for submission to the University's IRB committee. A "boot camp" written and performance exam is administered by the lab director to each trainee to verify that each trainee is expert in their data collection procedures.
3. Approximately 10 hours of training in the development, construction and testing of stimulus presentation programs.
4. The actual recruitment and testing of participants. Our staff monitors the first five live tests to verify that the trainee is proficient in all aspects of the procedures from recruitment to pre-test setup, to data collection and data backup.

5. Next, trainees receive approximately 15 to 20 hours instruction in basic data analysis procedures, using the data they collected.
6. Once data analyses are completed, trainees are assisted in developing conference submission abstracts. Once the abstract is submitted, we work with the trainee to expand the conference abstract into a journal article for submission.
7. Once two manuscripts are submitted to journals, we then work one-on-one with trainees on their initial grant applications.

The central and most critical component of this training model defines the Center's overall objectives, the faculty it engages, the types of training that it provides to students and faculty, the choice of journals to which participants will submit manuscripts, the character of the publications themselves, the types of grant applications that faculty will submit, and, ultimately, the impact and reputation of the Center, which is to say how it defines itself and its contributions in the context of world science. In our case, the choice in light of the faculty initiative seemed preordained. Faculties composed of individuals from different disciplines were seriously committed to adding a neuroimaging approach to their research investigations. They had already submitted proposals for funding to support such a plan. They had asked and worked with Administration to pursue this goal. At the same time, they were not interested in abandoning their mainstream areas of expertise to become neuroscientists. They had already established significant reputations in their major fields of study. Rather, they wanted to remain expert in their disciplines while addressing broader questions that they believed the addition of a neuroscience perspective and methods would aid them in addressing. These faculties were already engaged in mentoring students and teaching courses in their disciplines while making serious efforts to broaden their own approaches to the sciences. The training model, as a consequence, had to provide them with the skills and knowledge to integrate the neuroscience literature and methods in combination with their existing research methods to address those interests. They were willing to invest their most precious commodity, their time, in taking the chance that adding these new approaches would enable them to make significant and even major breakthroughs that would take their fields of study to new levels of understanding. While most neuroimaging centers engage outstanding neuroscientists who utilize various imaging tools to address a range of neuroscience and behavior questions, our Center planned to take experts in a much wider range of behavior research than is currently addressed by such centers. It would then provide them with the tools and training that in combination with their broad behavioral science expertise would lead to breakthrough science in domains never addressed.

Current Progress and Plans for the Future. In the 10 months since the Director was hired to help organize, focus and train interested faculty and students, much has happened. Across five two-day workshops (Step 1 of our seven step training program), 134 faculty and students were in attendance. Presentations on the Center's resources, training and

goals were presented to 26 departments across all colleges of the University. In addition, presentations were made to a number of state, medical school and hospital groups regarding Center goals and initiatives. Collaborations have now been established with two hospitals in Lincoln and one in Omaha as well as with the Medical Center in Omaha. Three faculty have already been sponsored for NIH K award submissions and six students have submitted NSF predoctoral training applications and NIH NRSA training applications. A competitive State of Nebraska Research Initiative grant for $1.2 million was awarded that augmented funds for purchasing imaging and computing equipment for the Center. In the meantime, plans are finalized for installing the 3T fMRI in temporary housing so that research using the magnet can hopefully begin in January. The building, with plans finalized for housing the Center, is now under construction with a completion date in early 2013. In the meantime, five high-density event-related potential /EEG systems are being used by faculty from three different departments to address research questions that are unique to their particular fields of interest. Another 30+ faculty and students are continuing their training through the 7-steps outlined earlier. This fall and winter will be a critical time for the Center. The hope is that spring will see manuscripts being submitted from faculty and students citing a literature and using neuroimaging techniques that were unknown to them a year ago. Especially noteworthy and critical to our goals is that these manuscripts will break new and fertile ground in their own areas of expertise that have never been addressed before in the neuroscience literature. The success of the faculty, students and Center are intertwined. The excitement is palatable. While the future is never certain, all the tools needed for success are here. The most important of these of course is the talent, enthusiasm and energy possessed by the faculty and students to conduct cutting-edge science!

Evolutionary Neglect of Aging: An Opportunity for the Behavioral and Social Sciences

David Ekerdt, Director, Gerontology Center; Professor of Sociology,
University of Kansas

Several years ago I found myself at a wedding rehearsal dinner in Kansas City, and seated beside me was the President of the Kansas State Senate. We fell into conversation and he asked me what did for work, and I said that I worked for the state, that I was a professor at the University of Kansas, in Lawrence. (At this point, it is important to know that my university has two primary campuses. Our Medical Center campus is in Kansas City and the main campus of the university is in Lawrence, 40 miles to the west.)

The conversation continued. And what did I teach? Well, about aging, gerontology. And the Senator was puzzled: "Aging? In Lawrence? Not the Medical Center?" So I went on to outline my teaching and research interests along with those of my colleagues in Lawrence, and the Senate President seemed happy to hear about all of it.

But I get this with some frequency: Aging—now isn't that a medical matter? So I dust off the same reply that I used at the rehearsal dinner to explain what we are teaching and doing about aging at the *non-medical* campus in Lawrence. And here I'm going to reprise that line of conversation for you as a way to meet up with the theme of this Merrill Conference, in particular, the role of the social and behavioral sciences in addressing human development, potential, competence, and, yes, health in the second half of life.

One strategy would be to list the many topics, initiatives, breakthroughs, and achievements of the behavioral and social sciences in this regard. Such material, for example, is featured on the website of the National Institute on Aging and is surveyed in the pages of major handbooks (e.g., Binstock & George, 2011; Schaie & Willis, 2011). Rather than itemizing things, I am going to review with you part of a single theory in order to explain "what I am doing in Lawrence." One of the advantages of a good theory is that not only does it organize observation and explain the things observed, it can suggest what it is that we should do in the way of research and action-taking.

The author of this theory was the late Paul Baltes, a psychologist at the Max Planck Institute in Berlin, who was the leader of a sprawling international network of scientists concerned with human development across the life span. As a prologue to his general theory of life span development, "selective optimization with compensation," Baltes outlined the basic biological and cultural architecture of human development

(Baltes, 1997). He argued that this architecture is progressively less complete across adulthood and into later life. This contention about incompleteness is what I will review here. As I proceed, I don't want it to escape your notice that I am a sociologist showcasing the theoretical ideas of a psychologist in order to endorse their applicability to many disciplines.

Evolutionary Fitness Declines

Three principles support the proposition about incompleteness (see Figure 1). As the first principle, Baltes observed that the benefits resulting from evolutionary selection diminish with advancing age. The exact shape of the left-hand curve that depicts this principle in Figure 1 does not matter for purposes of this argument. The main takeaway is this: that as life goes along, there is less fitness from our biological design. (For the remainder of this presentation, the theory is that of Paul Baltes, but the glosses are my own.) The hook that I have used in teaching evolution and aging on both KU campuses and to the public is that "You are not supposed to live past 40." I explain that evolutionary selection operates to make successive generations of the organism better and better at reproduction. However, once reproduction is underway, the force of natural selection diminishes and abnormalities begin to accumulate in the genome. Humans begin to see the expression of these flaws already in their 30s, and multiple conditions, impairments, and diseases only become more apparent in subsequent decades (Austad, 2009; Olshansky & Carnes, 2001). About all this falling apart, I don't need to go into detail.

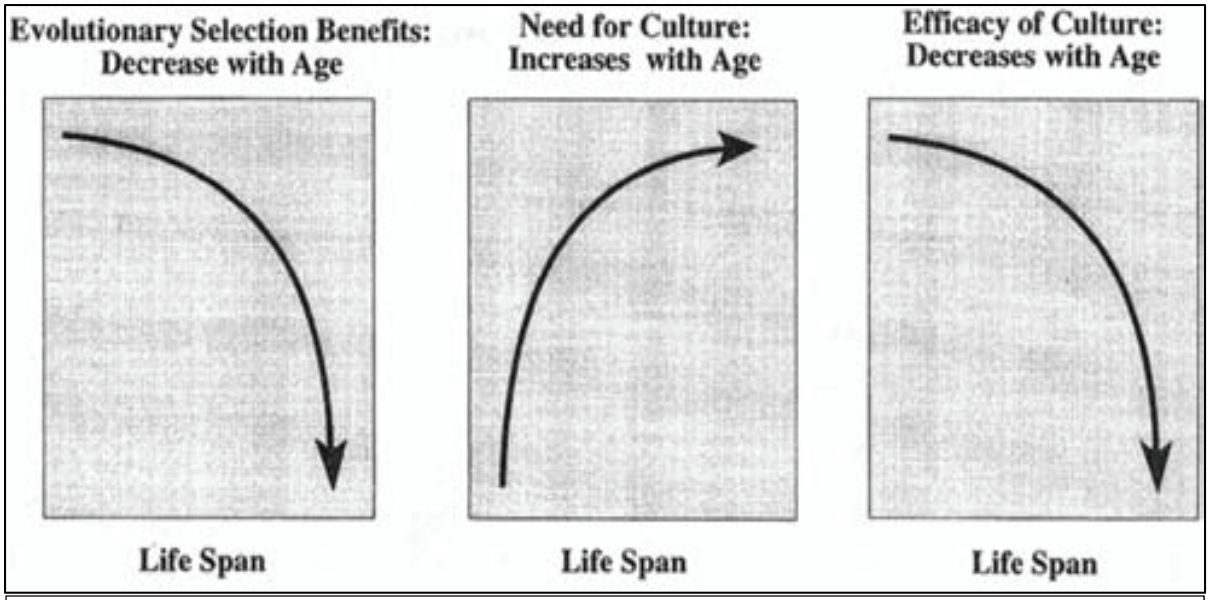

Figure 1. Schematic representation of three principles governing the dynamics between biology and culture across the life span. From "On the Incomplete Architecture of Human Ontogeny: Selection, Optimization, and Compensation as Foundation of Developmental Theory," by P.B. Baltes, 1997, American Psychologist, 52, p. 367. Copyright 1997 by the American Psychological Association. Reprinted with permission.

Aging, therefore, is the "afterwards" of life's big objective for all animals—the production of offspring. In human scale, we have a biological design to carry us to 40 or 50 as we generate, parent, and (according to one hypothesis) grandparent the next generation, and then we are obsolete, biologically pointless. My listeners generally find this message depressing. Nonetheless, I push on to tell them that this is actually good news! And for two reasons.

For one thing, the bodily manifestations of aging that we dislike (such as wrinkles, sagging skin, joint problems, hearing deficits, hypertension, diabetes, prostate trouble, osteoporosis, etc.) are ultimately not our fault! They are part of our biological inheritance. Yes, you are falling apart, but it's probably nothing you did (unless you accelerated things with bad choices). Rather, you can blame all that accumulated junk in the genome.

For the other silver lining, recall that I said that there is evolutionary indifference to post-reproductive life, that it's just an "afterward." So we are not designed to last, but the good news, at the same time, is that is that *we are not designed to fail*. Evolutionary neglect of this period of life of means that aging does not have a genetic program. There is no design, plan, scheme, timetable reliably winding us down. If we are not destined to deteriorate on schedule, then there are many ways to have a beneficial effect on the rate of decline or the onset of symptoms. There is a dividend of evolutionary neglect, and this is welcome news, indeed! With some effort and some luck, human life can extend well past the reproductive period—we can live past 40 or 50 or twice longer still. And this space left by evolutionary neglect should be of enormous interest to the behavioral and social sciences.

Though I am here to discuss the second half of life, I must recognize that there is likewise enormous scope for the behavioral and social sciences in the biologically "fitter" front end of life. Humans are born with a radical "world-openness," underdeveloped relative to other species with drives "unspecialized and undirected" (Berger & Luckmann, 1967: 47-48). The process by which human *organisms* become human *beings* takes place in specific environments, cultures, and social orders, so to say, in the case of humans, that the environment is an "adjunct" or "input" to growth and maturation is far too tepid a way to put it (Dannefer & Kelley-Moore, 2009). We derive our very humanity from the social world around us, and so the life course is socially constructed from its first moments.

It is an amazing transformation. Little drippy people with unregulated emotions are trained, habituated, socialized, and educated to codes of behavior, knowledge, and concrete social realities (Elias, 1978). They become sufficiently civilized to attend prom and then matriculate at our great universities for polishing. How this works—the creation of adults—for good or ill, and how it could be done better, is a wide field for the behavioral and social sciences. How this works also seeds potential direction for the rest of life.

Culture Compensates

Resuming discussion of the second half of life: What, then, compensates for the falloff in evolutionary benefit? Bal-

tes's second principle (Figure 1, middle) is that there is an age-related increase in the need or demand for culture. "Culture" here is shorthand for all sorts of knowledge-based resources: psychological, economic, material, technical, symbolic. It encompasses advantages from public health, educational strategies, literacy, human rights, medical care—all the fruits of human ingenuity. Not everyone has equal access to these resources, and so advantage (or disadvantage) cumulates across the life course leading to disparities in well-being and function (Herd, Robert & House, 2011).

The progressive importance of culture-as-compensation across adulthood can be readily imagined with instances of technological assistance, such as hearing aids and dental restorations. But let me illustrate with some aspects of social structure.

Example: The seniority principles that are built into many work organizations. As a reward for loyalty and past productivity, older workers in such programs are compensated with a rising wage and sheltered from direct competition with younger workers who may have more strength and stamina. In this way, senior workers' experience, skills, and institutional knowledge are conserved for the organization.

Example: Social security systems and pension arrangements that guarantee a level of financial security in later life. Unlike the long horizon facing younger economic actors and savers, older people have less time to recover from financial missteps or catastrophic losses. Women, because of their longer lives, typically lower earnings, and greater chance of widowhood, stand in even greater need of insurance against want and privation in retirement (Ekerdt, 2010).

These two examples regarding seniority and social security programs warrant a comment. The last 30 years, unfortunately, have seen a rising ideology that aims to undo these organizational and financial arrangements—arrangements that collectivized risk (Hacker, 2006; Schulz & Binstock, 2006). In their stead, individuals are living with greater uncertainty under the banner of "individual responsibility," an ideology that brings more risk—employment, investment, and financial jeopardy—and more stress into the lives of adults.

Example: Social and especially family support. The hallmarks of adulthood are independence and agency. But in later life there comes a time of growing dependence on others for the accomplishment of daily tasks. People fiercely resist this dependence (just try to convince an elder to stop driving), but by the 70s and 80s some supportive measures have typically begun. In our culture, this support responsibility falls to families and, by and large, they knock themselves out (National Alliance for Caregiving and AARP, 2009). At often great cost to themselves, they step in to manage money, provide rides to a medical appointment or the store or church, help with household maintenance, and even undertake personal and bodily care of older relatives. No doctor writes an order for this, but it is what keeps people alive. These caregiving activities are also a deposit *into* culture because they are, in turn, a lesson to the next generation.

Example: The motivation of health behaviors. Just about all the advice about healthy practices that we will ever need we learned in junior high: Eat a healthy diet, exercise, get enough sleep, don't smoke, drink in moderation, practice safe sex. Young people, biologically fit and feeling themselves to be indestructible can be heedless of this guidance. But, beginning in middle age, this advice needs restatement with even more effective techniques of persuasion. Especially to men, who are less likely than women to engage in preventive health and self-care, particularly if they have strong masculinity beliefs (Springer & Mouzon, 2011).

How can we get people to double-down on such no-brainers as exercise and healthy eating so as to delay the raft of diseases that flow from our comfortable affluence and the marketing of harmful products? Behavioral change toward better health has been identified as the top challenge for social science (Giles, 2011). Harvard University recently assembled a panel of scholars to articulate the hardest, unsolved problems that social scientists should tackle, and this is what topped the top-ten list: How can we induce people to look after their health? These efforts are all the more urgent with reports that advances in life expectancy have stalled in some segments of the population. In one recent report (Kulkarni et al., 2011), life expectancy in 80% of U.S. counties fell in standing between 2000 and 2007 against ten benchmark nations with the best life expectancies. Women have fared more poorly than men. A good number of these counties are economically disadvantaged, but progress can be made everywhere with public health campaigns and innovative messaging to address smoking, obesity, and other preventable causes of death.

Having cited these four examples about the rising need of culture, I'm wary of painting later life as a time of increasing neediness and dependence. This is not a one-dimensional season of life. Through their civic engagement, philanthropy, and family involvement, older people make great contributions to society, community, and kin, but that is a topic for another time (Morrow-Howell, 2010).

But Culture Is Less Efficient

So with advancing age, evolutionary benefits weaken, but culture compensates. However, there is a third principle about incompleteness (Figure 1, right). According to Baltes, there "is an age-related loss in the effectiveness or efficiency of cultural factors and resources" (p. 368). There remains plasticity and the potential for life long development, but the scope of plasticity narrows with age and interventions wane in power.

Example: Learning continues, but it is compromised. Older adults, owing to declines in sensory, cognitive, and physical abilities, learn more slowly and have more problems acquiring new knowledge. In a complicated world, with ever more sophisticated information flowing at us--technical, legal, financial, medical—we have to find ways to modify speech, written materials, instructions, visuals, and learning conditions so that older adults are not left behind, so that their full participa-

tion in our increasingly technological world is not compromised (Berg, 2008).

Example: The built environment. Our houses—they have been great places to live, raise a family. Bedrooms upstairs; family room, laundry, and workshop down in the basement. Outside: nice sized yard, big driveway, quiet streets, no busy traffic. This form of housing, suburban housing, is where over 50% of older people reside, but it lacks many of the features, qualities, and services necessary to support the well-being of older persons (Frumkin, Frank & Jackson, 2004). Traditional suburban design loses its efficacy when one cannot climb stairs, clear snow, mow the grass, or drive, leaving people isolated on islands of property that no longer fit their capacities. This is an issue—optimal places to live—that needs the creativity of, among others, architects, designers, and urban planners.

Example: The stuff *inside* that house. Those possessions were all acquired and accumulated to furnish daily life or support the development of the self (that fishing gear, those gardening tools). Some of it displayed one's station in life (sets of china, shelves groaning with impressive books). However, the ability to manage and maintain a houseful of stuff can come into question, its disposition a matter of concern and a potential obstacle to living in a more suitable place (Smith & Ekerdt, 2011). How do we convince people to release this material convoy that has sustained their identity?

So, the goods and affordances that were necessary and supportive only 10 or 20 years earlier—the information one needs to have or master, that comfortable property and all its contents—become less helpful.

My last example is not of things supplied from without, but a resource from within: the sense of time and how much of it is left. Longer life expectancies (the biblical four-score years) allow adults the imagination of things that *could yet* happen or *could yet* be tried, second chances, reinventions, projects, and dreams. This is the great shining promise of retirement, for which people start saving decades in advance.

Yet in later life people begin to sense their finitude. Research has shown that the subjective sense of time-growing-short can have "profound effects on basic human processes, including motivation, cognition, and emotions" (Carstensen, 2006: 1913). As one outcome, intimations of mortality can channel goal-directed behavior and so promote additional personal development even as the life-world narrows. Death, the great deadline, makes things matter (Baars, 2010). However, another outcome can be a sense of despair and frustration about what is no longer possible. In either direction, the resolution of this problem of meaning will have consequences for those to whom our lives are linked. In these matters, if you hear me suggesting a role for social psychology and mental health professionals, I am. If you hear me suggesting a role for the humanities, I am doing that, too.

Conclusion

To sum up, this architecture, as outlined by Baltes (1997), sets the possibilities and limits on human development over the life course. The human life course in its later reaches is a social and

cultural construction, but certainly one that we can manage and direct. I said at the outset that a good theory conveys a program of action. In the case of human development across adulthood, the research program for the social and behavioral sciences requires, as a basis, great skill in the characterization and interpretation of within-individual change. This topic has already been a conference focus of the Merrill Advanced Studies Center (Little, Bovaird & Card, 2007).

And the theory-driven, action program is this: (1) Appreciate (but do not exaggerate) the contours of declining bodily fitness. (2) Analyze how cultural habits, social structures, human ingenuity, and a will to survive extend life and promote welfare. (3) Devise ways by which this support can be optimized, to the end. For the behavioral and social sciences, there is plenty to do. And in the future there is really going to be plenty to do. This year, 75 million Baby Boomers—nearly one-quarter of the American population—begin to turn 65. The members of that cohort are going to be a large and irresistible market. They are going to buy things, want services, and seek experiences. A workforce will need to be trained to serve that market.

And for that market, the best of our social and behavioral work on life-span development can be translated into products, services and experiences. For example: settings for learning and self-development; user-friendly communications and computing technologies; furnishings and modifications for livable homes; effective health promotion programs, especially for the underserved; techniques and devices for self-care, self-regulation, and stress reduction; methods for building the skills of older drivers; programs to support volunteer caregivers; community organizations that can harness the talents and altruism of seniors who are themselves volunteers; management techniques for the accommodation of older workers; tools from behavioral economics to assist people in making financial choices and in evaluating risk; investment and insurance products designed to secure financial well-being; and modalities that harness social networks for the transmission of information, resources, and influence.

What am I doing in Lawrence? I'm attending to something—later life—that is a not a disease, but rather normal part of life, one with considerable potential for development, productivity, and good health.

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