FOSTERING RESEARCH IN THE SOCIAL, BEHAVIORAL, AND ECONOMIC SCIENCES AT THE NATIONAL SCIENCE FOUNDATION IN THE NEXT DECADE

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National Science Foundation
Directorate for Social, Behavioral and Economic Sciences

Arlington, VA USA

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PREFACE

In August 2010, the Social, Behavioral and Economic Sciences Directorate of the National Science Foundation (NSF/SBE) invited members of concerned research communities to submit white papers outlining the future of their sciences on a decadal scale in a project named "SBE 2020: Future Research in the Social, Behavioral and Economic Sciences." Prospective authors were encouraged to describe foundational and transformative questions in the content of their science, the skills and capabilities required to pursue those questions, and the infrastructure of services and resources that would enable such research. NSF/SBE was especially interested in the scientists' ideas about big questions that were likely to drive next generation research in the social, behavioral, and economic sciences.

The response has been astonishing—and formidable. Astonishing for the quality, scope, and depth of the 252 papers that were successfully submitted; formidable for precisely the same reasons. Months of analysis and discussion of the papers demonstrated that research communities might delve productively into subsets of the papers but that summarizing the entire corpus risked minimizing much important nuance. Moreover, despite the richness of the response, the papers do not collectively constitute a representative sample of all of the SBE sciences or of all potential suggestions for their future.

Within the framework of the questions posed, the papers are remarkably coherent in their recommendations for the shape and form of future SBE research while articulating significant research questions within individual domains of study. This report outlines strategies and priorities to foster research at the shared level of the SBE sciences over the next decades and also recognizes the continued role of expert opinion and knowledge within each domain. The title "Rebuilding the Mosaic" evokes balances between complexity and coherence, and between continuity and change: like a mosaic, the SBE sciences are individually distinctive yet fit together, employ a diversity of methods and techniques, are tractable and intelligible at multiple levels and scales, and engage a broad range of participants—students, established scholars, policy makers, and citizens. But this project also concerns adapting long-standing relationships among the existing SBE disciplines to reflect new challenges and interests arising from the research community, hence the notion of "rebuilding."

This report is our work, conducted in consultation with others at the Foundation, and with many others outside its structure. When we speak in the first person (which we do on occasion), we are describing our actions and thoughts, as we read the white papers, spoke with others and listened to their ideas and opinions, and interpreted what we read and heard. At all other times, we write about NSF activities and programs, and about possible actions in the future. We also anticipate a complementary report in the coming months from the Advisory Committee for the Social, Behavioral and Economic Sciences, which was consulted at key milestones and heard and discussed initial findings. The members of the Advisory Committee have had complete access to all of the papers. Their independent report will reflect their expertise and ideas about the SBE sciences. Taken together, these two reports should help NSF/SBE plan for future scientific activities.

On behalf of the National Science Foundation and the Directorate for the Social, Behavioral and Economic Sciences, we are grateful to the authors of the white papers for their willingness to develop their ideas and for their generosity in making their work available to us and to the broader scientific community. We also wish to thank our colleagues in higher education and advanced research, the professional associations, and the Foundation. To recognize them individually would require many pages; we hope that they will accept our silent acknowledgment of their contributions to the future of science on behalf of the American people.

Myron Gutmann
Amy Friedlander

October 2011
Arlington, Virginia

EXECUTIVE SUMMARY

This report presents the findings of a year-long study of the programmatic priorities of the National Science Foundation's Directorate for Social, Behavioral and Economic Sciences (NSF/SBE). The central activity was a Web-based, open call for 2,000-word white papers in which authors would describe decadal scale research needs and opportunities in at least one of three areas: driving questions; the human capacity to pursue those questions; and the infrastructure to enable those activities to proceed. A total of 252 manuscripts were successfully uploaded to the system, and all but a handful of papers, held back at the authors' request, have been posted to the public website (http://www.nsf.gov/sbe/sbe_2020/). Analysis of the papers was supplemented by site visits and discussions with colleagues. From these activities, the report concludes the following:

- Interest in the social, behavioral and economic (SBE) sciences is broad, deep, and varied, reflected both in the characteristics of the researchers and in the range of the science that they pursue and believe will be possible.
- Future research will be interdisciplinary, data-intensive, and collaborative. That vision rests on thorough grounding in the core SBE sciences that continue to present important, discipline-based research and methodological challenges.
- The research community looks to NSF/SBE to provide leadership and direction in building capacity and infrastructure, most notably in interdisciplinary training (capacity-building) and infrastructure (data and facilities to support analysis, simulation, tools, and training in new research methods, including integration and synthesis across data, methods, and disciplines).
- Four major topic areas have been identified within the wealth of ideas received: population change; sources of disparities; communication, language, and linguistics; and technology, new media, and social networks.
- NSF/SBE's existing programs serve their communities well. New topics, especially multidisciplinary ones, may invite a more flexible structure within the directorate.

NSF/SBE will continue to explore new ideas in the future, concentrating over the next five years on more focused planning activities that will (1) strengthen the ability of the directorate to support interdisciplinary research, develop human capacities, and build out the data and organizational infrastructure; and (2) consider approaches required to shift resources to relevant priorities. The highest priorities go toward planning and implementation:

- Devote attention to evaluating and implementing ideas and recommendations in the white papers that concern existing programs.
- Enhance interdisciplinary research with initial preference given to four areas: population change; disparities; communication, language, and linguistics; technology, new media, and social networking.
- Develop planning activities to test ideas for new data and infrastructure services.

NSF supports the basic research and education that enable advances in many areas including technology-based innovations that spur economic prosperity; understanding, mitigating, and adapting to climate change; developing sustainable approaches to the utilization of energy, water, and other natural resources; and transforming undergraduate education for the preparation of tomorrow's leading scientists.

—*Empowering the Nation through Discovery and Innovation, NSF Strategic Plan for Fiscal Years (FY) 2011-2016,* page 3

1 SOCIAL, BEHAVIORAL, AND ECONOMIC SCIENCES IN THE YEAR 2020: A VISIONING EXERCISE

The modern world confronts Americans with a series of challenges that call for integrated responses across the full range of sciences. Innovation and competitiveness in the future knowledge economy; coastal zone management and disaster response; and local, regional and global migration are but a few of the near and long-term problems we must tackle. Equally important, successes in social network analysis, behavioral economics, decision making, and neuroscience, together with robust data sources and computational tools, offer analytical methods and approaches that are capable of supporting both traditional and collaborative research at potentially new scales, from the cellular to the global. Now in the second decade of the 21st century, researchers in the social, behavioral and economic sciences (SBE) face a basic question about the structure of advanced research: How well does a model of research that arose in the context of industrialization a century ago and owes much to understanding industrial life fit in a post-industrial, knowledge-based future? And, as a science funding agency, how should the National Science Foundation (NSF) plan for future research?

The NSF/SBE is unique in that it houses a mosaic of related programs enabling fundamental research in crosscutting topics by combinations of economists, political scientists, sociologists, geographers and spatial scientists, psychologists, linguists, neuroscientists, anthropologists, and other social and behavioral scientists. Through the NSF/SBE directorate and its two research divisions, Behavioral and Cognitive Sciences (SBE/BCS) and Social and Economic Sciences (SBE/SES), the Foundation funds more than half of the university-based social and behavioral sciences research in the nation. But much has changed since the Foundation was established in 1950 and the directorate itself created in 1992. The entire research enterprise is open to reconsideration: its organization at all levels from teams of investigators up through the funding agencies; the content, approaches, methods, and evidence of the science; standards and processes for evaluation; modes of communication and presentation; and, perhaps most significantly, the ways students are educated and faculty are encouraged to grow intellectually and to undertake research on behalf of the nation. As a purely practical matter, business as usual, even for advanced research, is not an option.

This document and the companion website (http://www.nsf.gov/sbe/sbe_2020/) are the results of a visioning exercise that began in August 2010. Research is a social process, transmitted across successive generations of teachers and students and, increasingly, conducted in teams using shared resources. The computational revolution in research that has taken place over the last 20 years has created a technologically networked community with the capacity to connect researchers in new ways. For NSF/SBE, it provides an opportunity to try a form of crowdsourcing to gather information as an alternative to the customary academic workshop in which scholars discuss current research and enumerate future needs and opportunities.

An approach based on modified crowdsourcing had a particular advantage: NSF/SBE did not have to make a priori decisions about who should be represented in the discussions by choosing some disciplines or some members of the scientific community over others. Instead, as described in more detail in the next section, NSF/SBE released an open call and waited to see who would respond. This visioning exercise became an experiment in the strengths and limits of an open process as well as a view into the issues and priorities of the scientific community. This chapter discusses the process and what was learned from it. The next chapter offers observations about the substance of future SBE science, and the final chapter lays out a set of priorities and activities for going forward.

ASKING FOR HELP: BACKGROUND AND METHODS

NSF relies heavily on consultation with the scientific community to set priorities. Program officers build relationships with their disciplinary communities and the annual cycle of proposals, merit review, and awards constitutes one channel of communication about interests and priorities. As do other directorates, the NSF/SBE has a standing advisory committee composed of domestic and international experts who meet semi-annually to review the directorate's programs. Their advice is supplemented by outreach to professional organizations and by Committees of Visitors who examine individual programs and whole divisions. Finally, the science staff remain actively engaged in their communities as working scholars, and a variety of speaker series offer opportunities to listen to leading figures within the SBE sciences and across the Foundation.

However, the usual mechanism for framing a new program or initiative is a workshop or set of workshops, convened by the National Academy of Sciences or by university-based Principal Investigators. Scholars are invited to participate in meetings and to formulate consensus opinions around a set of questions. The preliminary findings are vetted, and a final report, setting forth recommendations, is presented to the Foundation. Such studies establish the consensus view by experts of the research landscape, and many have been highly influential. Three recent reports that take a notably comprehensive and integrated view of the SBE sciences deserve special mention: *World Social Science Report 2010: Knowledge Divides* (UNESCO and the International Social Science Council, 2010); *America's Global Climate Choices* (Committee on America's Climate Choices, National Research Council, 2011); and *Social, Behavioral and Economic Research in the Federal Context* (Subcommittee on Social, Behavioral and Economic Sciences, National Science and Technology Council, 2009). Such studies are time consuming. *America's Global Climate Choices* is actually the fifth report in a series that is part of a suite of activities organized two years ago by the National Research Council. Even in an exercise as broadly construed as *America's Climate Choices*, participation is necessarily limited, and most such efforts are not nearly as ambitious.

An alternative approach is to ask the members of a directorate's advisory committee, in this case the Advisory Committee for the Social, Behavioral and Economic Sciences (http://www.nsf.gov/sbe/advmembers.jsp), to provide specific advice about future scientific priorities. NSF/SBE has done that and the SBE Advisory Committee is at work on a complementary report containing ideas and recommendations that they have developed independently. [1]

In an effort to take the pulse of the research community more quickly and more nimbly, NSF/SBE tried something different, a form of controlled crowdsourcing. NSF has good mechanisms for reaching its community. Using its website, email, and more up-to-date media that include Facebook and Twitter, NSF can get the word out. Ways of communicating back to the directorate are more limited. Investigators meet with program officers informally, but aside from the planning exercises that have been described, most researchers communicate with NSF/SBE through the formal process of submitting proposals for new individual research projects. Could new media and forms of communication, which are currently used within the Foundation to publicize activities, also be used to establish another channel for communicating ideas back to the directorate? And would the responses to a relatively unrestricted call for ideas be sufficiently cogent to justify eliminating a layer of editorial vetting and judgment by experts that is an important component of the approach exemplified by the National Academies' reports and similar studies by experts?

One advantage of the networked research community is that NSF can reach researchers directly via a diverse collection of email lists, relying on individuals to forward messages to their circles of colleagues and to unleash constructive viral communication that simultaneously transmits information and creates awareness. A second advantage is the pivotal role of NSF program officers in

[1] Members of the SBE Advisory Committee were advised of the intended launch of this visioning project at their semi-annual meeting in May 2010. Updates and reviews of preliminary findings, conclusions, and recommendations were presented at the November 2010 and May 2011 meetings. These were all public meetings; procedures complied with requirements under the Federal Advisory Committee Act (FACA).

building scientific communities. An important component of that role is outreach, which means that not only do the program officers explain the directorate's priorities to the research community, but that they also listen carefully and represent a front line in understanding where the research is going. To tap into that collective expertise, in June 2010 NSF/SBE program officers wrote short statements outlining future research directions. In many ways, their responses prefigured the larger response from the research communities. They described a diverse set of issues, but their observations also converged around three main topics:

- Important questions (the fundamental science questions)
- Data and infrastructure (data-intensive science, methodologies, research centers, shared toolkits, and so on)
- Capacity building (education and training of graduate students, faculty, and systems of prestige, promotion, and recognition)

These three topics became integral to the next phase of the project, expanding the call for ideas out to the research community.

For the interactions with the research community, NSF's outstanding technology group built an interactive website (www.nsf.gov/sbe/sbe_2020/) that described goals and allowed authors to upload papers. To announce the project, NSF/SBE used an existing mechanism called a "Dear Colleague Letter" that was posted in August 2010. The letter was distributed by email to all active NSF/SBE Principal Investigators and to more than 90 individuals associated with other federal agencies, professional societies, organizations, and academic departments. From those modest efforts, the Dear Colleague Letter was distributed to a much larger universe of individuals, both inside and outside NSF/SBE's customary scientific community. Mention in *Newsweek* and a story in *Inside Higher Education* (http://www.insidehighered.com/news/2010/08/16/nsf) provided additional—and favorable—exposure.

Barriers to participation were intentionally as low as possible. Anyone with an idea was able to come forward. Authors were encouraged to write essays of no more than 2,000 words in English that would address one or more of three topics: fundamental research issues, the capacities required to pursue the research, and the infrastructure to support it. Authors provided a Creative Commons license (creativecommons.org) for each submission in order to ensure a clear statement of their intellectual property rights. There was no process of evaluation or ranking of content; "acceptance" meant that an essay was successfully uploaded to the system. NSF/SBE staff checked each document to make sure that it spoke to at least one of the three questions and that an appropriate rights license had been conveyed. Participation was voluntary and self-initiated. The name of the corresponding author, title, and abstract would be posted as a condition of participation,[2] but names of contributors were considered confidential until the deadline had passed, and authors retained the right to withhold public release of the full text of their papers. In post processing, NSF/SBE staff standardized aspects of the presentation, removed duplicate submissions after consultation with the authors, and converted the files to PDF for public access.[3]

The results of this "experiment" in opening a government research agency to public suggestions for research are obvious: people have been eager to tell NSF about the future of the SBE sciences, and to do so in imaginative ways.

The results of this "experiment" in opening a government research agency to public suggestions for research are obvious: people have been eager to tell NSF about the future of the SBE

[2] *SBE 2020: White Papers, Titles, Authors, and Abstracts* was released in late February 2011; see http://www.nsf.gov/sbe/sbe_2020/Abstracts.pdf.

[3] Conversion to PDF was done internally, rather than by the authors, to insure that the files complied with ADA Standards for Accessible Design (http://www.ada.gov/stdspdf.htm). The submission system was designed to reject papers that were not submitted in a Microsoft Word ® compatible format for precisely this reason: to make sure that the eventual public access papers were uniform and consistent with relevant federal requirements.

A VIRTUAL CONFERENCE WITH THE COMMITTEE ON INSTITUTIONAL COOPERATION (CIC)

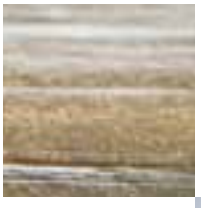
Leaders of the University of Illinois at Urbana Champaign (UIUC) noticed that the call provoked an interesting cross-campus discussion resulting in submission of 12 papers in which faculty, researchers, and graduate students in many centers and departments were either corresponding or co-authors in multi-institutional teams of papers that covered environment, public health, technology, race, and violence. Given this broad interest, the university leadership organized a teleconference in which seven CIC institutions participated along with NSF/SBE: University of Illinois, University of Michigan, Michigan State University, University of Minnesota, Northwestern University, Ohio State University, and Penn State University.

The organizers asked participants two questions: (1) what two or three themes in the white papers did they find most exciting? and (2) what two or three important topics were missing from the collection? Participants agreed that data, infrastructure, and interdisciplinarity were important, along with network and complexity theory, developmental science, integration of biological and social systems, and the science of social science. Other topics were either omitted or poorly represented: theory and models; decision making; problems related to race, access to natural resources, violence, governance, and translational research; communication and citizen science. Highest priority should be given, they argued, to global ecosocial change, structures of difference and inequality, linguistics, and integration of social and biological research with attention to biomarkers and neuroscience.

Going forward, the UIUC called for maintaining the lines of communication and building out their collective expertise in data curation, analysis, and collection. The Illinois Data Stewardship Team has planned academic year 2011-2012 as the "Year of Data Stewardship" on the UIUC campus to begin in early October 2011. Activities will engage faculty and staff from the Library, School of Library and Information Science, Office of the Vice Chancellor for Research, Campus Information Technologies and Educational Services, and several academic departments and will address ways to meet NSF's requirement for data management plans in all grant applications.

Joel Cutcher-Gershenfeld,
University of Illinois at Urban-Champaign






sciences, and to do so in imaginative ways. The original deadline of September 30, 2010 was extended, and by the time the process closed on October 15, NSF/SBE had received 252 white papers from diverse contributors (discussed in more detail in the next section and in Chapter 2). Representatives of other groups provided additional information. They included: American Sociological Association, Coalition for Networked Information, American Economic Association, Association of American Geographers, Consortium of Social Science Associations, Federation of Associations in Behavioral and Brain Sciences, National Communication Association, a group of philanthropic associations in a small meeting in New York City organized by the Alfred P. Sloan Foundation, and several boards at the National Academy of Sciences. The two authors of this report visited the University of California (UC), Berkeley and the University of Texas (UT) at San Antonio, and participated in a virtual campus visit with seven members of the Committee on Institutional Cooperation (*See sidebar page 10*). The agendas for these meetings included three broad questions: Where are the gaps? What is missing? What are the priorities? Consistently, students, young faculty, and well-established scholars described ways that the process had stimulated their imaginations, even among those who were not able to contribute a paper. Relatively little was actually said about gaps and omissions. Rather, there were lots of ideas about priorities, next steps, and actions the Foundation and the directorate could take.

FIRST LOOK: WHO RESPONDED?

More than 500 people submitted ideas by uploading white papers as individual authors or as members of author teams. In the interest of minimizing barriers to participation, very limited information (metadata) from the corresponding author was included as part of the submission, and the profile of authors is based on that subset. Clearly, this is not a scientific sample, and there is no claim that it is representative. It does show that with the help of the professional associations and others who helped publicize the Dear Colleague Letter and the networking efforts of the NSF/SBE division directors and program officers, the message—that their ideas, thoughts, and opinions would be heard and taken seriously—got out and resonated broadly. As will shortly become obvious, NSF/SBE received relevant responses from people and places outside of our usual communities.

The vast majority of the corresponding authors are working in the United States, but authors in five additional countries (Canada, the United Kingdom, France, Portugal, and Israel) also contributed. In the United States, 41 of the 50 states are represented; of these 17 are among the 29 jurisdictions that NSF identifies in its EPSCoR (Experimental Program to Stimulate Competitive Research) program (Appendix 1). Corresponding authors self-identify with 148 institutions, including universities, museums, libraries, not-for-profit organizations, and corporations (Appendix 2). Based on the Carnegie Classification of Institutions of Higher Education, nearly the full range of schools is represented from Baccalaureate Colleges through Research Universities (with very high research activity) and Special Focus Institutions, such as medical schools and centers.

People work in a variety of settings (Appendix 3). Of the 214 corresponding authors who reported a department or unit within a larger entity, 97 (about 45 percent) described themselves as members of one of the traditional SBE academic departments (economics, sociology, political science, linguistics, psychology, geography, and anthropology). Another 22 were in departments of health sciences, communication, and education. The remainder—about 45 percent of the 214 who reported this level of affiliation—represents a fascinating diversity: computer science, classics, cultural heritage, business schools, engineering, medical schools, a host of interdisciplinary centers, and many who reported more than one affiliation. More detailed examination of the full lists of authors, not yet quantified, adds an additional layer of complexity. Authors[4]

[4] White papers are identified by the family name of corresponding author. In instances in which two corresponding authors share the same name or the same author contributed two papers, the paper is identified by family name and White Paper ID, an identifier assigned by the system and used for version control. A complete list of the white papers with corresponding author, title, and White Paper ID is included in Appendix 5.

THE ECONOMISTS' CONTRIBUTION

Among the white paper authors who participated in the AEA panel were (L to R): Nicholas Bloom, Stanford University and National Bureau of Economic Research; Esther Duflo, Massachusetts Institute of Technology; James Poterba, Massachusetts Institute of Technology and National Bureau of Economic Research; and Emmanuel Saez, University of California, Berkeley

The NSF/SBE directorate's economics program has a distinguished record of achievement, so it is not surprising that 28 of the 214 corresponding authors who provided departmental affiliations (about 13%) self-identified with economics departments (Appendix 3) and that 39 papers, about 15% of the total (Appendix 4), were assigned to economics as a field of study; a total of 132 papers address economics and economic issues or implications, testifying to the fundamental importance of economic analysis either within its disciplinary framework or as a contributor to multidisciplinary approaches.

Perhaps again not surprisingly, recent events in the financial markets clearly affected these authors' thinking (Blume; Diamond; Fischer; Gintis; Glaeser; Hubbard; Kroszner; Poterba; Rogoff; Van Reenen) as did energy and environmental concerns (Berry; Stavins). The core papers in economics cover questions in macro- and microeconomic research, infrastructure, theory, and data. But most go substantially beyond narrowly defined, traditional economic interests. For example, many authors describe interdisciplinary approaches to well-established topics, among them the nexus of education, employment and gender (Autor); incentives (Samuelson); global challenges (Nordhaus); risk (Diamond; Ericson; Hansen; Tierney); markets, market design, and market collapse (Blume; Rogoff; Roth); choice, decision making, markets, and bounded rationality (Glaeser; Gruber); consumer financial behavior (Collins; Gruber), to name only a few. In the body of this report, several places are identified where these papers, and others, contribute to broad, crosscutting themes.

The American Economic Association played an important role by encouraging the economics community to participate in the SBE 2020 effort and by organizing a panel at the January 2011 meeting in Denver, Colorado. At 8 a.m. on a sunny Saturday morning, every seat was taken; people sat on the floor and stood in the hallway to listen. Senior economists have encouraged us to use the papers as the basis for planning and establishing priorities. Fifty-four papers have been independently collected into an open-access publication through the Social Science Research Network where the papers are also individually accessible. See Schultze, Charles L. and Newlon, Daniel H., Ten Years and Beyond: Economists Answer NSF's Call for Long-Term Research Agendas (Compendium) (July 15, 2011). *Ten Years and Beyond: Economists Answer NSF's Call for Long-Term Research Agendas,* Charles L. Schultze and Daniel H. Newlon, eds., American Economic Association. Available at SSRN: http://ssrn.com/abstract=1886598

included at least one citizen scientist (Patterson), one university president (Scholl), and two physicians (Cohen; Kleinman), together with many academics, administrators, independent researchers, and probably more than a handful of graduate students. Several of the papers were submissions from professional associations and societies: National Communication Association (NCA); Population Association of America (PAA); Society for Public Health Education (SOPHE); Context Subcommittee of the Outcomes Committee of the Community Engagement Key Function Committee of the National Clinical and Translational Science Awards Consortium (CTSA); University Consortium for Geographic Information Science (UCGIS); American Political Science Association (APSA). Several more had multiple cosignatories or people other than authors who endorsed the paper. One list of coauthors numbered more than 60.

The white papers themselves exhibit a similar diversity. When the papers are categorized by field of study, using a simple taxonomy provided by the National Center for Science and Engineering Statistics (Appendix 4. Table 4.2; Appendix 5, column 3), the largest single

category—about 17 percent—is "social sciences, general," which meant that the papers addressed issues that transcended any one of the fields of study. Economics came in second followed by communication and linguistics, psychology, political science, sociology, education, geography and urban studies, anthropology and archaeology, health sciences, computer and information science, and demography. These represent about 93 percent of the white papers; the remaining 7 percent span mathematics and statistics, public administration, humanities, business management and administration, and atmospheric science and meteorology. The next chapter discusses both the high level of coherence and the underlying diversity of the collection and what that suggests about future SBE science. Before that, the balance of this chapter discusses a few lessons learned from this experience gathering information.[5]

LEARNING FROM THE PROCESS

This experiment in collecting information in a relatively unstructured way shows that interest in the SBE sciences is broad and transcends simple disciplinary boundaries. Yet the research itself also possesses a deep unity that may be expressed in highly domain-dependent terms that impedes communication between a neuroscientist and a linguist, for example, both of whom might be studying language. Exposing the intellectual architecture of the SBE sciences is actually quite challenging. In their very diversity, the white papers might be interpreted—unfairly—to illustrate a cacophony of interests that are only loosely connected. Moreover, despite the generous outpouring of contributions, the set of papers is still quite small. There are legitimate questions about the extent to which it adequately captures the full range of the SBE sciences and, even more important, the relative priorities of the respective topical clusters of papers. This observation illuminates the important role that expert opinion and advisory groups will continue to play in assessing gaps and articulating opportunities for domain-specific and interdisciplinary research.

Individuals and small groups of collaborators as well as a range of collective enterprises contributed white papers. At one extreme was a well-organized effort by the American Economic Association to spread the word and encourage leading scholars to contribute essays as individuals (*See sidebar page 12*). At the other were responses by professional associations speaking for their communities. Finally, there was a middle ground in which the Dear Colleague Letter stimulated conversations on campus, exemplified by the experience of the CIC, which led to individual submissions and a loose coordination among the authors that has persisted beyond the writing of the papers. Since the submission process ended, other individuals and groups have also come forward with ideas about how to expand upon the white papers and the crowdsourcing process and to encourage NSF/SBE communities to examine relevant issues and to enable good science. Such deliberations have always been a feature of research, but this process seems to have catalyzed energetic discussions. Sustaining this momentum and devising ways to incorporate the expertise of citizens, scientists, and professional groups will be important going forward.

[5] Two similar projects deserve mention. The Division of Social Science in the Faculty of Arts and Sciences at Harvard University, with support from the Indira Foundation, launched a year-long exercise to identify the "hard problems" in the social sciences with a symposium on April 20, 2010. The formal presentations were then augmented by crowdsourcing through a project website and Facebook. A description of the project and the results are available at: http://socialscience.fas.harvard.edu/icb/icb.do?keyword=socialsciencedivision&tabgroupid=icb.tabgroup105281. A second exercise is in progress at the National Institutes of Health, Eunice Kennedy Shriver National Institute of Child Health & Human Development, which has organized meetings and workshops and posted white papers for comment around six Vision themes: Behavior, Cognition, Development, Developmental Origins of Health and Disease, Diagnostics and Therapeutics, Environment, Plasticity, Pregnancy and Pregnancy Outcomes, and Reproductive Outcomes together with 16 crosscutting issues, including measurement, bioinformatics, epigenetics/meta-genomics, bioethics, global health, and training and mentoring. See: http://www.nichd.nih.gov/vision/vision_themes/index.cfm.

It would be folly to set up a program under which research in the natural sciences and medicine was expanded at the cost of the social sciences, humanities, and other studies so essential to national well-being.

Vannevar Bush, *Science: The Endless Frontier: A Report to the President,* July 1945

NSF's dual mission—of funding the best ideas and the best people—drives NSF's reach to the furthest frontier in every research discipline, and, increasingly, *between* disciplines.

Subra Suresh, *Speech to President's Council on Advisors on Science and Technology,* January 6, 2011

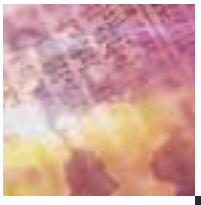
2 WHAT DID PEOPLE SAY? THE CONTOURS OF SBE RESEARCH AND ITS PROGRAMMATIC IMPLICATIONS

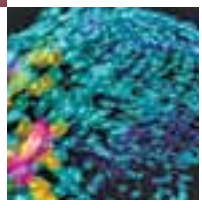
Vannevar Bush's influential report in 1945, quoted at the head of this chapter, led directly to the organization of the National Science Foundation with the clear understanding that its role would be to strengthen basic research in science that took place outside of government, primarily in colleges and universities. Thus, unlike one of the national laboratories, NSF does not itself conduct research; the Foundation fosters new research, incubates ideas, and in so doing advances the nation's intellectual infrastructure by supporting institutions, resources, and people. Indeed, along with others, the Foundation (and hence the directorate) are knit into the fabric of that research infrastructure, by signaling priorities based on input from the research community. So it is a symbiotic process of listening and leading in which torrents of good ideas are filtered, categorized, and ultimately prioritized. Here, the task is to select priority areas from the wealth of ideas where there is interest, in some cases embryonic; where it may be difficult to find support because topics cross traditional boundaries; and where sustained investment is likely to engender cross-fertilization of ideas and yield benefits across a number of areas of science.

A synthesis or summary would probably not do justice to the breadth and depth of individual papers or groups of papers, so NSF/SBE will make the collection available indefinitely to encourage detailed reading of them and to enrich future and more focused discussions. This chapter explores the unifying architecture—the themes that define subsets of papers or appear as supporting ideas in others and common interests that are independent of disciplines or specific problems—and four topics that pose promising avenues for interdisciplinary work.

PARTITIONING THE COLLECTION

Chapter 1 described the corresponding authors' background and the first level of analysis of the collection, classification by field of study. Ninety-three percent could be characterized as "social sciences, general," which meant that the papers addressed issues that transcended any one of the fields of study, or as economics, communication and linguistics, political science, sociology, education, geography and urban studies, anthropology and archaeology, health sciences, computer and information science, and demography (Appendix 4). More refined analysis (Appendix 5, columns 5 and 6) based on tagging the papers with several keywords yields a wealth of interests and topics: globalization; public health and health disparities; public goods; monetary and fiscal policy; auctions; game theory; complexity; neuroscience, brain, and behavior; crisis and disaster prevention and management; sustainability; data, information management, and archiving; theory; integration with biology and the physical and natural sciences; collaboration as object of study; learning; migration; consumer behavior; creativity; "commons" problems; social media and social network analysis; civic engagement; global climate change; urbanization; criminology and gang organization; ethics; education and learning; race, gender and lifestyle; and more. While exciting intellectually, this rich diversity poses a programmatic challenge: how might the long-term questions be differentiated from immediate research problems? Where were the challenge questions that would unlock related discoveries across a number of fields? And how could the directorate develop programs that enabled a broad vision of collaborative, multidisciplinary, integrative research *and*





also supported focused research in existing programs, which are both discipline based (sociology, economics, political science, and so on) and cross-disciplinary (for example, cooperative programs with the Biological Sciences [BIO] and Computer and Information Science and Engineering [CISE] directorates)?

The science that these papers collectively envision is data intensive, multidisciplinary, collaborative, and frequently problem-oriented.

Given the sheer volume of material, NSF/SBE commissioned a clustering analysis by the Institute for Quantitative Social Science at Harvard University (IQSS) to help navigate the range of topics and ideas (*See sidebar page 17*). Its analysis revealed many ways to characterize the collection using computational techniques. The quantitative analysis also confirmed that two ideas transcended the entire collection: some authors wrote about the character of future SBE science, that it would be multidisciplinary, collaborative, data intensive, and so on, and then addressed the human, informational, and technological resources required to pursue that type of research. Other authors wrote directly to the basic science. Many of these authors also emphasized interdisciplinary, integrative research and noted the importance of the supporting human and informational infrastructure, but their focus tended to remain on the science itself and the direction of the research.

To some extent, this is not surprising. The three guiding questions posed in the Dear Colleague Letter encouraged writers to look at scientific content, capacity, and data/infrastructure. But in reading the papers, the consistent focus on multidisciplinary and data-intensive research, the implications of that type of research for the way NSF/SBE conceptualizes its programs, and some impatience with the existing topical structure of the directorate were both surprising and intriguing.[6] Some of the topics raised in the papers are already served in existing crosscutting and discipline-based initiatives and programs. Global environmental change is one example of an interdisciplinary topic in which interest and resources have been mobilized both within the Foundation and in other agencies. From the perspective of looking forward a decade or more, however, the totality of the white papers shows that the directorate needs a strategy to use the papers to reconsider the standing programs, to find programmatic ways to cultivate emerging research interests that do not fit within the existing structure, and to evaluate the need for more investment in data and infrastructure. The remainder of this chapter expands on what the papers say about the ways SBE research should be done in the future, and then describes four crosscutting themes that offer opportunities to support new ideas.

CONDUCTING NEXT GENERATION SBE SCIENCE

The science that these papers collectively envision is data intensive, multidisciplinary, collaborative, and frequently problem-oriented. Indeed, the tension between the problems that the SBE sciences should address and the kind of research that SBE scientists should undertake in pursuit of those problems came up in our conversations on campuses as well as in the collection of papers. At UC-Berkeley, for example, senior scholars called for both problem-focused research and enhanced data collection projects. In his white paper, Nordhaus explicitly recommends that the directorate "solicit and recognize the research on aspects [of] global public goods" to address a series of global challenges—environmental change, financial crises, cyber warfare, and nuclear proliferation—by setting priorities within existing programs. Other authors made similar

[6] We are aware that there is probably a self-selection effect. Thus, continued consultation with the community, as described at the end of Chapter 1, is necessary to mitigate that bias.

A TOOL TO HELP READERS READ

Grouping items into categories is fundamental to human thought, but human cognitive capacities are limited. Even with the best intentions, humans are likely to filter new information through preexisting opinion. Gary King and his colleagues at Harvard University's Institute for Quantitative Social Science address this set of problems with their computer-assisted clustering approach, which seeks to help readers—or analysts of any type of data—discover meaning in otherwise undifferentiated information, for example, press releases, memoranda, or, in this case, white papers. Unlike a text mining or topic extraction technology, which seeks to identify themes or topics in a collection, computer-assisted clustering provides multiple views of a given corpus based on the notion of a "clustering." A "clustering" denotes the output of a cluster algorithm applied to the subject corpus that shows how the items in the collection are grouped within the entire set. This means that an investigator is not limited to a single cluster algorithm, which may be optimized for a slightly different problem, and the approach becomes a means of helping investigators examine their assumptions and see conceptual relationships in a given corpus using all known cluster algorithms. The set of all clusterings is presented visually as a polygon where each point represents a clustering. Points that are near to one another are similar and points that are further away are dissimilar. A detailed explanation of the system is provided in Grimmer and King (2011).

The interactive system allows for varying levels of granularity. The investigator can run the algorithms to display, for example, 5, 10, or 18 clusters of papers within a clustering, and then can compare results of using different algorithms applied to the same corpus of material. The output includes a table in which the investigator sees how individual items—in our case, white papers—group according to the algorithm. The idea, then, is to read groups of papers and from that to think about how the papers relate.

As part of the project, the Institute for Quantitative Social Science experimented with several ways of conceptualizing the corpus. Interestingly, the team did not find that the programmatic organization of the NSF/SBE directorate was particularly helpful because "most of the White Papers emphasized ideas that crossed these boundaries" (King 2011:1). Five examples of clusterings based on different algorithms at different levels of granularity are presented below:

TWO EXAMPLES OF 5 CLUSTERS

1) Study of Communities (Particularly the Academic Community) (119)
2) Technology (45)
3) Economic Markets (43)
4) Neuroscience and Culture (19)
5) Additional Topics (17)

1) Economics (82)
2) Political Systems (49)
3) Education (42)
4) Data Science (37)
5) Language (33)

TWO EXAMPLES OF 10 CLUSTERINGS

1) An Economic Approach to Problem Solving (72)
2) Data and Data Collection (32)
3) Community Problems (29)
4) Interdisciplinary Science (27)
5) Information Flows (21)
6) Psychology, Genetics, Language (16)
7) Digital Infrastructure (15)
8) Computational Tools/Text Mining (11)
9) Historical Work (10)
10) Other (10)*

1) Data (47)
2) Economics (32)
3) Surveys (29)
4) Language (26)
5) Social Systems (22)
6) Universities and Scientific Cultures (21)
7) Education (21)
8) Political Systems (17)
9) Other (17)*
10) Race/Gender/ Evolutionary Theory (11)

ONE EXAMPLE OF 18 CLUSTERS

1) Education and Interdisciplinary Work (22)
2) Political Systems (19)
3) Social/Cultural Studies (18)
4) Language (18)
5) Survey Research (15)
6) Markets Policy and Medicine (15)
7) Social/Political Change (14)
8) Anthropological Studies (14)
9) Markets and Game Theory (14)
10) Preserving Data (12)
11) Community Research (12)
12) College, Youth and Race Issues (12)
13) Neuroscience (11)
14) Behavioral/Evolutionary Psychology (11)
15) Social Systems and Collective Intelligence (10)
16) Data Infrastructure (10)
17) Collection/Availability of Economic Data (9)
18) Networks/Spatial Methods of Analysis (7)

The number in parenthesis indicates the number of papers in the subset. This analysis is based on the preliminary set of 244 papers; 8 papers were subsequently added to the set.

Sources: Grimmer, Justin and King, Gary. Proceedings of the National Academy of Sciences of the United States of America, February 3, 2011, vol 108 no 7 2643-2650 doi: 10.1073/pnas.1018067108. http://gking.harvard.edu/files/201018067_online_1.pdf

King, Gary. NSF Contract Final Report: Analysis of 244 White Papers (February 2011). In possession of SBE/OAD.

* The category did not convey meaning that was relevant in this context.

recommendations for problem-oriented multidisciplinary research, frequently to address global challenges, including tensions between globalization and national and local interests, values, and cultures (Berry; Foran; Frodeman; Geller; Hubbard; Liang; Neuberg; Viatori).[7] From a variety of perspectives, the white paper authors describe new ideas and ways to advance the science. They see the potential for interdisciplinary research and training and for new and better data and tools to access and analyze the data. In addition to data, there were several ideas for expanding the nation's research infrastructure and making it more collaborative. These ideas ranged from building on the notion of "clinical trials" for social science interventions in support of policy and decision making to more familiar programs that would support summer institutes for young- and mid-career scientists, focused grant programs, and workshops and conferences. However, access to data also raises theoretical and methodological concerns (see *Theory, Experiment Design, and Methods are Important)*.

From a variety of perspectives, the white paper authors describe new ideas and ways to advance the science. They see the potential for interdisciplinary research and training and for new and better data and tools to access and analyze the data.

SBE Research is Interdisciplinary, Data Intensive, and Collaborative

Irrespective of topic, calls for interdisciplinary research and new or expanded data appear consistently across the otherwise highly diverse contributions. Many papers explicitly outlined the need for more interdisciplinary research engaging a wide variety of parent disciplines. Authors cautioned that the terms "interdisciplinary," "multidisciplinary," or "transdisciplinary" may have been used unproductively (Boskin), and systematic training in methods of interdisciplinary research (Bosque-Perez) and synthesis (Littell) is required. The spatial sciences and geographic frameworks for analysis are deeply embedded in the disciplines and in the way that scholars articulate issues.[8] Interdisciplinary research across economics and psychology—behavioral economics—is familiar in advanced research circles (for example, Cutler) as are projects involving cognitive psychology, genetics, and computer science. Papers about environmental and climate change point to the importance of integrating data and synthesizing results across archaeology and anthropology, sociology, politics, technology, ecology, and other natural sciences, including astronomy (Boyer; Broadbent; Chapin; Denning; Findeis; Foran; Harden; Kintigh; Laituri; Lee; Leigh; Masse; Medin; Nelson; Neuberg; Nordhaus; Sayama; Scarborough; Walsh275). Papers about urbanization and migration make similar connections (Barton; Dooling; Kim; Sellers; Smith101), and papers about risk, decision making, and vulnerabilities call for integration of combinations of neuroscience, cognitive psychology, economics, sociology, political science, and technology (Coulter; Ericson; Hamm253, Hamm310; Hansen; Jarvenpaa; Koschmann; Loughran; McClelland; Tierney; Tonn). Finally, a relatively small group of papers describe the multiple dimensions of studying group behavior and organizations (Bonito; Cresswell; Koppl; Mendes; Pentland; Roberts; Schrodt157; Sun), and a handful of papers called for stronger integration with the humanities, especially history (Bjerk; Chilton; Corrigan; Daniels; Girju; Kroszner; McCloskey; Owens; Zaman).

[7] Charness has called for a radically different approach to funding, arguing that NSF/SBE should award prizes for successful research rather than financing projects. In a paper that also looks at procedural questions Kramer considers the role of Institutional Review Boards.

[8] White papers that address topics in geography and the spatial sciences include: Dooling; Ericson; Findeis; Foran; Geller; Gregory78; Harden; Hoeksema; Kasakoff; Lee; Lobao; Owens; Smith41; Smith101; Southall; Sun; Pentland; Yuan. An additional set of white papers combine spatial analysis with other disciplines, for example, demography, economics, engineering, globalization, health sciences, linguistics, data collection, and so on: Bhatt; Bowser; Chodzko-Zajko; Clark; Guterbock; Habashi; Hansen; Janoski; Leblang; Mendenhall; Moffitt; Neuberg; Nordhaus; Sayama.

Transcending disciplinary boundaries and investing in infrastructure challenge the traditional model of single-investigator or small team science (Ribes). Collaborative work, either on research projects or in the use of shared resources, would be the likely, but often unstated, outcome. As many observers have noted, collaborative projects have serious implications for attribution and credit and for existing systems of recognition, promotion, and tenure. Moreover, the best approach for achieving effective collaboration itself is by no means obvious. At least two papers (Bonito; Bőrner) focused directly on collaboration in scientific research as the object of study, and 31 more[9] talked about collaboration in some way, including challenges of communication in collaborative work (Hoffmann), collaboration among stakeholder groups and organizations at multiple scales (Korschmann; Roberts), and machine-machine and human-machine collaborations (Bongard) that, as exemplified by the smart phone, are becoming almost ubiquitous with respect to consumer devices. Highly instrumented environments are not far behind (Koppl). Others discussed the implications of globalization for collaboration and communication (Barton; Blankenship).

Papers about data are similarly both familiar—social scientists (in one guise or another) have supported large scale data collection efforts since 1948—yet also very different. Forty-four papers address data and tools to work with data. There is a wealth of proposals. Some call for new, updated, larger, or culturally diverse studies (Elias; Hoeksema; Kapteyn; Medin; Moffitt; Sastry) or longitudinal studies (Franklin; Hanushek); others for better integration with global data collection efforts and data in other sciences (Braden; Broadbent; Ribes; Southall; Kintigh; Weir). Several authors pointed out the potential of existing data being more easily accessed. These might be administrative data collected by federal and state agencies or commercial or opportunistic data sets, collected for a particular purpose or, like the social media sites, obtained in the course of business or captured from a device (Card; Haltiwanger; Hong; Pentland; Stockwell; Van Reenen).[10] Other authors described the advances that might derive from embedding data into geographic information systems and from expanding existing Geographic Information Systems (GIS) to include historical data (Corrigan; Gregory78; Kasakoff; Owens) or analyzing data at a more granular level (Kasakoff). Yet another group called attention to the potential value of linguistic (Aristar; Campbell; Crane; Hale; Pye; Wagers; Warner) and cultural heritage data and collections as elements of the research infrastructure (Daniels; Kintigh) or transformed into machine-readable form and geo-coded (Barker; Lyons). Format conversion—transforming information typically from analog to digital—remains an area of research, posing technical issues, especially for three-dimensional objects, as well as economic, management, and legal questions (Greenstein). Finally, a number of authors outlined more topically specialized data collections (Aristar; Bloom; Brady; Granato; Jorgenson; Medin; Reis; Segal) or refinements to existing survey data (Hofferth; Smith41). The distinguishing characteristics across the entire set of data-oriented papers are the tremendous potential scholars see for examining both standing and new kinds of questions, including the phenomenon of social media itself (Berube; Greene; Hirsh; Hong), and the extent to which large data collections, interdisciplinarity, and collaborative research are conceptually closely coupled (Cook; Hackett; Hoffman; Kintigh; Weir).

Working with Data Provides Opportunities to Rethink the Organization of Research

The notion of collaborative research teams is one way that data-intensive SBE research implies a shift away from the independent, single investigator/small team model of scientific research. As the previous section suggests, ideas about collaboration, data, technology, and infrastructure are closely intertwined. Accessing and working with data and collections, especially heterogeous data, data at scale, or data that are sensitive, pose significant issues that overlap with proposals for new kinds of research infrastructure.

[9] In addition to the authors noted in the text, collaboration is discussed at some level by: Adamick; Bohnemeyer; Cavarretta; Chapin; Collins; Cook; Corrigan; Ericson; Everhart; Goldsmith; Gregory186; Hackett; Hansen; Jarvenpaa; Jindra; Kleinman; Laubichler; Ribes; Roberts; Sastry; Scholl; Schunn; Sellers; Southall; Tierney; Warner; Yuan.

[10] Administrative data sources are not without problems, for example, missing values; Cardinale discusses the related statistical issues.

Access to different sources of data raises new issues about experiment design and methods as well as the more familiar concerns about inadvertently disclosing sensitive information.

Several authors addressed the importance of metadata to enable management, integration, and analysis (Gregory186; Heus; Southall); the challenges of working with very large datasets (Imbens), and tools, such as analytics, to interpret and analyze data, particularly large quantities of data (Poole; Yuan). Others addressed the context in which data, particularly sensitive data to which access must be restricted, might be organized and made available. Card, Franklin, and Hanushek described data enclaves as one approach. More generally, Barton, Bosque-Perez, Hackett, Kuhn, Levine113, and Ribes in their respective papers lay out somewhat different notions of a center where support, computational resources, training, and access to analytical and modeling tools, diverse data, and expertise could be assembled to test different models in a culture where interdisciplinary, collaborative research is nurtured.

Duflo, Varian, and Wright call attention to the importance of testing ideas and theories. Varian outlines ways that the SBE sciences might undertake the equivalent of clinical trials for possible interventions, and Wright describes the value of mounting large proof-of-concept projects that exceed the funding typically available for small-scale research projects. Rather than relying on relatively small samples, syntheses or meta-analyses of multiple studies as a way to assess the implications of a possible policy, NSF/SBE might maintain a laboratory or a center that was equipped with data and tools, including "economic diagnostics" as outlined by Rodrik, to enable a relatively large scale simulation of the results of the proposed intervention and an evaluation of the utility of the models. This idea has immediate relevance for the type of translational research, community interventions, and economic policy decisions that public health researchers (Kleinman; Livingood) and economists (Hubbard; Levine113; Poterba) believe may be possible within the framework of the SBE sciences.

Theory, Experiment Design, and Methods are Important

Theory helps investigators make sense of data and enables prediction (Hart). Access to different sources of data raises new issues about experiment design and methods as well as the more familiar concerns about inadvertently disclosing sensitive information. Moreover, relatively new theoretical approaches (for example, complexity) as well as access to computational technologies and tools (for example, gaming and matching algorithms) have enabled and will continue to enable simulation as well as data-based arguments. A relatively small but interesting group of papers focused on broad questions of theory, method, and approach: sampling, scale, and diversity (Cardinale; Imbens; Medin); mathematics and statistics (Barzilai; Cardinale; Imbens; Jans; Yatzhaki); modeling (Bowser; Brown74; Granato; Hansen; Schrodt157, Schrodt197); complexity and suppleness (Katerndahl; Page; Sayama); agent-based approaches (Gintis); game theory[11] (Fudenberg; Mitchener; Raymond); and variation (Whalen64). Several papers address issues of theory and measurement within disciplines (Boskin; Hart; Hoeksema; Scheff; Wagers) and as a means of bridging across scales and enabling prediction. For example, both Wilson and McCullough look to evolutionary biology and evolutionary science as possible sources for a unifying theory, and Lo asks, can a complete theory of human behavior be developed that is predictive in all contexts? Finally, many papers, while not focused on theory,

[11] Note reservations about game theoretical models and financial markets voiced by Blume.

Research about the world's changing population crosses diverse research sectors—for example, aging in the contexts of household formation, gender roles, and the care of young children; continued employment; cognition and public health—and may yield unexpected cross fertilization of ideas and insights that might otherwise be difficult to expose.

method, and model-building, recognized the importance of all three in exploring different veins of research. Papers on complex systems (Cutcher-Gershenfeld) and social network analysis, as applied to a series of problems in environmental change, disaster response, communication, and economic behavior, also drew on these abstractions and saw the potential for problem-oriented research to contribute to the theoretical and methodological base (Blankenship; Findeis; Jackson; Pentland; Pescosolido).

FOUR CROSSCUTTING THEMES

Earlier sections of this chapter described ways to understand the collection of white papers that were independent of individual disciplines. These papers talk about broad attributes of SBE research and tease out implications of multidisciplinary, data-intensive, collaborative research that transcend individual disciplines or even fairly well-established integrative topics like global climate change or urbanization around which communities of researchers are coalescing. As the SBE directorate looks forward on a decadal scale, what topics, based on the papers, seem to attract interest across disciplinary boundaries and how might NSF/SBE encourage the multidisciplinary, data-intensive, collaborative research that SBE scientists seek to undertake? Four such topics are discussed in the following sections.

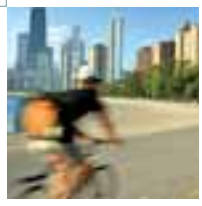
Studying Population Change is Fundamental to Unpacking Key Research Problems

Research about the world's changing population crosses diverse research sectors—for example, aging in the contexts of household formation, gender roles, and the care of young children; continued employment; cognition and public health—and may yield unexpected cross fertilization of ideas and insights that might otherwise be difficult to expose. Hoeksema[12] outlines a series of challenge areas in population studies. These represent a mix of theory and experiment design, gaps in existing data, and multidisciplinary topics; suggest the extent to which geography and spatial sciences, genetics, and environmental concerns have become embedded in the construction of research problems; and illustrate the deep connections between experiment design, the nature of the data, and the substance of the science. For example, identifying the mechanisms by which the social environment influences human developmental processes requires large, complex, and expensive surveys (as opposed to laboratory study), as well as definition of thorny problems characterizing the social environment. This compels investigators to make choices about conceptualizing the social environment (e.g., individual, peer-group, family, residential area, workplace, schools, etc.) and about the relative importance of cultural norms, institutional resources, environmental exposures such as pollution, and so on when designing a study.

These themes resonate across many of the papers. Authors link migration to urbanization, patterns of ethnicity and violence (Tapia), multiculturalism (Harris), and the development of regional innovation capacity (Walshok). Similarly, the broad rubric of "globalization" subsumes a set of interrelated processes, including population change, economic growth, and global shifts and disparities (Fischer; Van Reenen); immigration, skilled labor, and employment (Hanson); changes in language, involving both the extinction of some languages (Pye) and the development of more bi- and multi-lingual communities (Bhatt; Goldsmith); environmental change (Broadbent; Findeis); disaster response and resilience (Laituri; Liang); and human origins and early migrations, discernible in the paleontological and archaeological record (Clark; Gilbert).

Other papers also explore the nexus of demographic, societal, and economic issues from the perspectives of individuals, families, and households, or demographic cohorts and cultural groups. Alesina considers the potential for understanding global economic disparities from the perspective of comparisons in family and household structure. Collins, Hanushek, and Heckman link consumer financial behavior, human capital formation, and long-term economic growth to early cognitive development and household and family

[12] Hoeksema authored this statement on behalf of the Population Association of America (PAA) based upon input from the Association's members.



formation. Segal calls attention to the implications of modern military service on household formation and stability as well as employment. Altonji, George-Jackson, Rivers, and Russell consider relationships among children, child rearing, education, and social mobility. Habashi describes a transnational "youth culture," and Dwyer reflects on the implications of young university graduates burdened with debt. Autor, Johnson, Michel, and Viamonte look at issues related to gender, and Haftka, Poterba, Van Reenen, and Weir point to the multiple implications of a graying population and continued labor force participation beyond traditional retirement age. Finally, multicultural, transient, and aging populations pose a series of challenges and choices for educational and public health systems (Altonji; Brooks Carthon; Buckwalter; Coulter; Russell) as well as for governance and local, regional, and national political structures (Dickey; Neuby; Scholl), many of which may be sketched but not yet rigorously analyzed and understood.

...it is clear that research that responds to the issues raised by a changing population is integral to the mosaic of scientific approaches that are supported by NSF/SBE.

In the past, demographic research has fallen primarily within the portfolio of the National Institutes of Health (NIH), but it is clear that research that responds to the issues raised by a changing population is integral to the mosaic of scientific approaches that are supported by NSF/SBE. This is a rich interdisciplinary intersection. It invites cross-directorate as well as interagency investigations and links them to computer science, engineering, education, biology, and the geosciences (among others). Here, the Foundation's leadership is unmatched. An aging population needs new and specialized robotic assistive technologies, for example, just as a population that has disproportionately migrated to coastal regions needs social and behavior scientists—together with those supported by NSF's Geosciences and Engineering directorates—to study the implications of climate change and sea level rise. These complex topics call for contributions by geography, economics, the psychological sciences, anthropology, and sociology. They are also, at their core, about people—where they live, how they learn, and where they work, marry, establish households, have children, and grow old. Research along these lines shows how the sciences intersect and fold into each other in creative and meaningful ways that will transform science and the lives of Americans.

Future Research Can Explain Disparities in Experience and Access to Resources

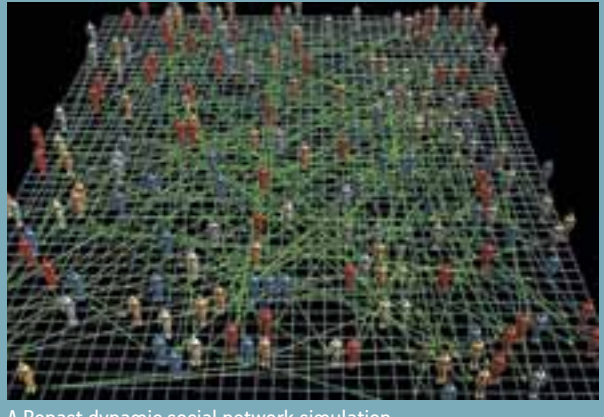
The sources of inequality constitute a long-standing question in SBE research. Alesina argues that the fundamental question in economics is why certain nations and regions have developed while others lag. He maintains, however, that this is not solely an economic question but rather one that requires the broad idea of culture, in particular, family traits. Also at the global scale and from the perspective of economics, Duflo calls attention to disparities in development, arguing for a combination of empirical and theoretical work as well as for better integration of microeconomic models and findings into coherent macroeconomic models to account for mechanisms of economic growth and distribution while Acemoglu looks specifically at the role of institutions. Janoski points to the convergences of global specialization, lean production systems, and advanced technologies; and Van Reenen highlights both the emergence of China (also Fischer; Sun) and the continued relative poverty of Africa as important topics for study. Laituri considers the relationship between global environmental change and the ability of regions and communities to respond to crises, on the one hand, and legacy social conditions, including land use or land tenure, poverty, institutional arrangements, and gender, on the other. Lobao examines geographic territory as the basis for stratification, pointing to spatial patterns of income inequality at multiple scales, residential foreclosures and commercial vacancies, investment and disinvestment, and the persistence of poverty, and Dooling addresses the roles of sustainability and urban planning as they contribute to social equity. Cutler,

AGENT-BASED MODELING AND COMPLEXITY

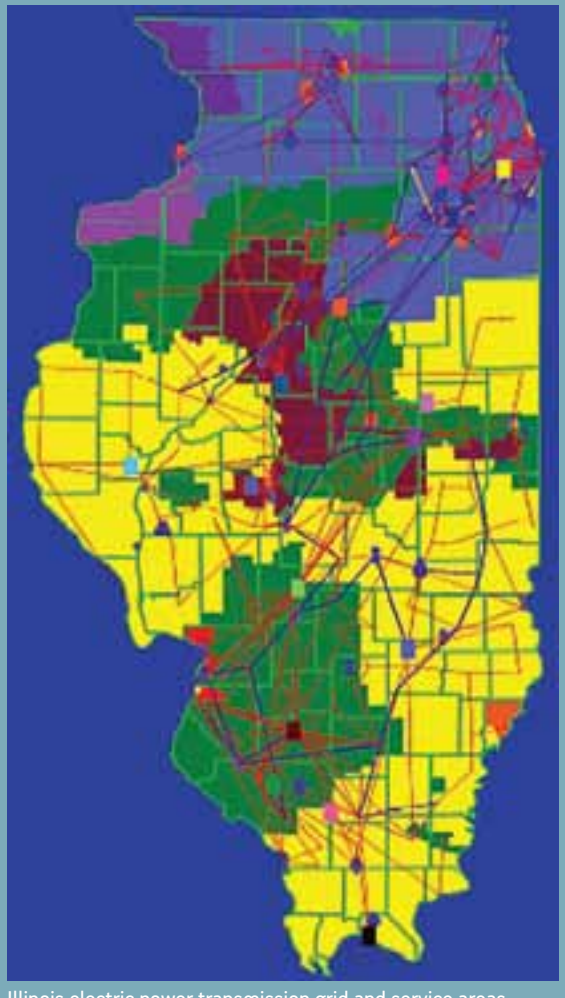
Agent-based models consist of a set of objects—agents—situated in place and time that follow and adapt rules of behavior. The modeler designs a system, sets the agents loose, and watches what transpires. The behaviors included in the models need not be ad hoc, mechanistic rules. They can be calibrated to actual behaviors revealed in the laboratory, identified in field studies, or discerned from empirical studies.

Many people conflate computational methods with complexity. This is a mistake. We must disconnect scientific methodologies from the properties of the systems that they are used to study. In point of fact, agent based models produce aggregate outcomes that fall into one of four broad categories: static equilibria, periodic equilibria (patterns), random paths, or complex trajectories. Social systems exhibit all these four behaviors as well. We see phenomena ranging from stable market prices, to random walks on Wall Street, to political cycles, to complex intra-industry dynamics. A goal of social science should be to explain why some processes produce outcomes that fall into one category and others fall into another.

—Scott E. Page, Complexity in Social, Political, and Economic Systems



A Repast dynamic social network simulation.

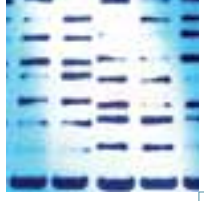


Illinois electric power transmission grid and service areas.

Source: AGENT-BASED Modeling and Simulation for EXASCALE Computing, SciDAC Review, Department of Energy, Office of Science, at: http://www.scidacreview.org/0802/html/abms.html

Funder, Gingerich, Levine169, and McCorriston outline multiple dimensions of individual development (and its variations), choice, and decision making from the neuroscience and the psychological sciences to anthropology and sociology and implications for social, political, and economic inclusion and exclusion, and Brooks Carthon, Dolezal, Funder, Gingerich, Hibbing, Jindra, Mendenhall, Stevens, Tapia, and Winant look at the mix of cognitive development, poverty, violence, race, ethnicity, and lifestyle at the individual, group, societal, and global scales. Finally, Page argues that addressing these multidimensional problems could be best achieved using an agent-based complexity *(See sidebar above)* approach that allows both for the integration of the contributions of multiple SBE scientists in the analysis as well as for improved prediction of outcomes.

White paper authors also talked about disparities in public health, education, and access to food (Leblang) and



to public resources like libraries (Arndt; Everhart32, Everhart33; Russell; Walsh289) as well as about the role of federal spending relative to employment (Reis). Darity considers the low rate of participation by black and Hispanic Principal Investigators among NSF's basic economics research grants, one of several papers that examine STEM (science, technology, engineering, and mathematics) education and research, including topics typically grouped under the rubric of the "pipeline," that is the education and training of future scientists and the underrepresentation of women and minorities (George-Jackson; Kolar; Roschelle). Another cluster of papers addressed issues in public health or health-related questions (for example, obesity), public policy concerning health, and the incidences of illness in different populations (Buckwalter; Brooks Carthon; Chodzko-Zajko; Clough; Cohen; Cunningham). A number of writers considered aging in one way or another, in addition to the public health aspects, overlapping with economics (Buckwalter; Poterba; Van Reenen), employment (Haftka), education (Dwyer), gender (Michel), communication (Rubin), child care, and family (Hoeksema).

The papers from both public health professional associations (Kleinman; Livingood) draw on SBE research as it contributes to defining ways that public health research is conducted. The papers implicitly acknowledge intersections between studying epidemiology and public health and their social, psychological, and economic contexts, a view clearly echoed in the current visioning exercise at the Eunice Kennedy Shriver National Institute of Child Health & Human Development (see footnote 5). Livingood calls for an "applied social and behavioral sciences" approach that balances complexity, interactivity, and sensitivity to local conditions with findings from formal controlled trials. The trajectory of smoking, he and his co-authors point out, reflects the importance of such broad, socially-based analysis, and Kleinman outlines a series of intersections between the SBE sciences and relevant evaluation approaches, including theory to support both simple and complex interventions; identification and measurement of relevant local variables; use of existing data to support generalizations; and relevant factors and metrics.

Studies of economic development, social stratification, and inequality overlap with population change and, as nearly all of these authors argue, are tractable in an interdisciplinary, collaborative framework. Additionally, authors who articulated the need to modernize existing large-scale surveys; integrate regional, national and international data collection efforts; or create new surveys justified the investment, in part, because of the ability of the data to support studies of inequality.

Why Can You Understand Me? Brain, Behavior, Communication, Learning, Language, and Linguistics

Communication, language, and linguistics form an arc of related papers that connect individually to expected and sometimes unexpected fields in different scales from neuroscience (Bohnemeyer; Smolensky), to signing, speech, and speech recognition (Rubin; Shih; Warner), to classics and historic languages (Crane). Another cluster of papers considers language as a cultural phenomenon (Bhatt) and issues in documentation and capture of endangered languages (Aristar; Campbell; Goldsmith; Pye). Communication, more generally, is a feature of studies of cognition, brain, and behavior, including comparative animal studies (Aron; Bohnemeyer; Brown; Cacioppo; Fragaszy; Hibbing; LaMuth; Preuss; Restivo; Wasow; Waterman) as well as education and political engagement (Baron; Cresswell; Farrell; Gingerich; Katz-Buonincontro; Pardo; Russell; Walsh275). Finally, Bach looks at communication as an exchange of information (rather than at language), which might, in principle, involve visual systems (in addition to language) and might encompass another set of related fields such as informal education and journalism.[13]

Bach argues, in particular, for the importance of understanding the communication of science. Although public confidence in science is reportedly at a historic low point, the demands for

[13] Bach wrote on behalf of the National Communication Association (NCA); we also attended the NCA leadership retreat, at their invitation, to discuss the project specifically and their ideas more generally.

communication in a knowledge economy are very high. Scientific communication, she maintains, should be understood as both private communication among scientists as well as public communication between scientists and citizens. These have different features and challenges illustrative of general problems in communication, not only those intrinsic to the specialized communication of scientific findings. In related papers, Hunter, Marchak, O'Gorman, Whalen57, Zalles, and Zvonkovic address public communication about science, including the role of citizen or public science, and Harley discusses systems of scientific communication and their role in the research enterprise and systems of prestige. Finally, Bjerk and McCloskey argue that rhetoric and choice of words have an independent effect upon the analysis, whether the analysis of scientific data or economic decision making. Johnson makes a similar argument from the perspective of gender.

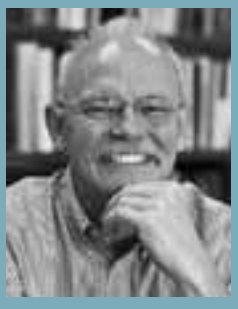
NSF/SBE maintains a program in linguistics. As program officers in the psychological sciences and in education as well as linguistics quickly pointed out, communication, language, and linguistics intersect to afford opportunities for cross-fertilization and theoretical advances. Documenting endangered languages and creating collections of existing documentation of now-extinct languages, a recommendation put forth by young faculty at UC-Berkeley, not only preserve the record, a significant cultural heritage goal, but also increase the diversity of languages amenable to study. This diversity is integral to understanding the biological bases and origins of language and hence engages the nexus of neuroscience, genetics, and cognition with implications for learning and other behaviors (Bender; Campbell; Goldsmith; Wasow). Finally, the arc of behavior, communication, language, linguistics, and neuroscience calls for integration across multiple scales and is an example of the need for methods to enable inference and prediction. Thus, deeper understanding of language has applications for advancing theory, on the one hand (Bender; Cacioppo; Restivo; Whalen64) and on the other, contributes to a number of issues in perception and computation (Oliva), including automated cross-language techniques, which have immediate relevance in an increasingly multicultural social and political environment (Goldsmith; Warner). Similar conceptual feedbacks and potential applications can be seen for brain, communication, language, and behavior (Aron; Restivo) *(See sidebar page 26)*; communication, rhetoric, economic, and political decision making and engagement (Cresswell; McCloskey; Pardo; Scholl); and education (Schunn; Strauss).

Technology Has Two Sides: A Source of Transformation and an Object of Study

Technology is an interesting phenomenon: it enables the science, and it is an object of study. The papers address both aspects. Advanced technologies have enabled observation of brain function and organization as well as computationally intensive modeling and data collection and analysis (Boker; Levine169). Most of the recommendations for advancing the infrastructure of SBE research are also computationally intensive—support for collaborative research, sometimes called "networks" of researchers (Cook; Sellers); more data, better and more sophisticated tools for data integration, analysis and visualization; and easier access to tools, data, and training in their use (detailed in *SBE Research Is Interdisciplinary, Data Intensive, and Collaborative)*. All of these ideas presume access to computational technology and the desire to take advantage of advances in such technology in ways that make sense for advancing SBE science. Although Page warns against conflating computation with complexity (*See sidebar, Agent-Based Modeling and Complexity, page 23*), he, nonetheless, describes a technologically-mediated approach to analysis, whether or not it employs an agent-based approach to unpacking complex systems, especially at scale.

Technology is also the object of study. Standards, for example, which are frequently understood as technical objects, embody a range of assumptions about language, material culture, and systems of governance (Busch). One cluster of white papers considers the implications of new technology, primarily the information and communication technologies, in organizations (Cresswell; Sun); politics and government (Arndt; Pardo; Scholl; Tonn); innovation (Sawyer; Sun); economics and economic modeling (Blume); energy (Watson); attention and behavior (Reis; Waterman); creation of knowledge (Fisk); and education (Arndt; Everhart32, Everhart33; Sawyer). The social media—Facebook, Twitter, and so on—attract substantial scrutiny as a phenomenon that embodies new communication and knowledge creation through crowd behaviors (Greene)

WHO ARE WE? THE EMERGING SCIENCE OF THE MIND



James L. McClelland, Stanford University

John T. Cacioppo, University of Chicago

Aude Oliva, Massachusetts Institute of Technology

"Psychology," writes journalist Malcolm Gladwell in his foreword to *Psychology and the Real World*, "is the art of giving the most unexpected and thoughtful answers to the most ordinary of questions" (FABBS 2011:xii). Some psychologists might bridle slightly at hearing their science characterized as "art" or their driving questions as "ordinary" but Gladwell intends these words as high praise. Indeed, psychology examines central questions about humanity in a conceptual progression from the molecular to the societal, asking questions about the nature of consciousness and relationships among people, and exploring one of the greatest mysteries of modern science, the human mind. Not surprisingly, then, references to brain, cognition, or psychology figure substantially in the white paper collection with related papers constituting about 19 percent (47 papers) of the corpus, many containing provocative ideas that intersect or resonate with other topics and disciplines.

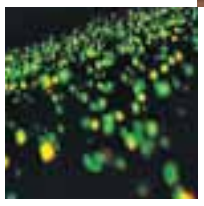
Notable for the coherence and breadth of its vision of an integrated "Science of the Mind" is a coordinated set of papers organized by the Federation for the Advancement of Behavioral and Brain Sciences (FABBS) and written by McClelland (lead author), Cacioppo, and Oliva. The framework for research laid out in these papers (echoed in others) reflects advances of the last 20 years or so, prospects for future research, and opportunities for collaboration and interdisciplinary work with a range of disciplines and applications, including computer science, engineering, and medicine as well as the social and behavioral sciences. Collectively, the papers outline several major goals for behavioral and brain sciences, the implications of achieving these goals, and the tools likely to enhance progress in this area.

McClelland and his co-authors point out that despite significant advances, many of the most fundamental questions about how neurons give rise to the emergent human mind have remained resistant to scientific inquiry. It is increasingly clear that interdisciplinary approaches are the only likely path to success in this area, and they describe a need for stable, long-term research collaborations, with team members who have expertise in disparate fields--neuroscience, psychology, computational science, linguistics, and engineering to name just a few.

Cacioppo looks more closely at understanding human social interaction and the challenges of establishing the mechanisms that shape human cognition and behavior at multiple scales. Human brains do not develop or function in isolation. Rather, by studying the brain and social dynamics together and in comparison with animal studies, a point also made by Preuss and Brown80, a greater understanding of brain, individual behavior, and society seems likely to emerge. Oliva considers these issues within the domain of perceptual science, where researchers seek to understand how physical properties of the brain can be used to explain how our rich understanding of the world emerges with potentially very practical applications. Artificial vision systems, she points out, have reached commercial application in digital cameras and online search systems, but the ongoing interaction between human perception and computer science promises to advance current understanding of the human brain.

As do others, these authors called for the establishment of large-scale databases, in which the results of many studies can be archived, combined, shared, and reinterpreted. McClelland, again like Varian, Hackett, and other authors who reflected on the organization of research, outlines possible research programs and training, and describes laboratory and other facilities that would provide an infrastructure of interdisciplinary research (see *Working with Data Provides Opportunities to Rethink the Organization of Research*). Finally, like many papers in the collection, these authors present a compelling vision of integrated, collaborative, and data-intensive research that has applications in the "real world," to use FABBS' term, while gradually unraveling one of our deepest scientific secrets.

Source: *Psychology and the Real World; Essays Illustrating Fundamental Contributions to Society.* 2011. Edited by Morton Ann Gernsbacher, Richard W. Pew, Leanetta M. Hough, James R. Pomerantz (Federation of Associations in Behavior & Brain Sciences by Worth Publishers, New York).



Papers that address social networking, technology, and new media embody a data-intensive, multidisciplinary, and collaborative approach seen in many of the white papers.

or collective intelligence (Hirsh). Anecdote and observation suggest that the pattern of responses, which may or may not be evident to the participants in the communication, may expose information, such as disease vectors, and may also consciously create new knowledge in the form of conscious crowd sourcing, but both dimensions have yet to be systematically studied. Hong shows how this work might be accomplished using sensors and mobile devices and also outlines some of the considerations, such as protecting individual privacy.

Hong used different kinds of locational and log data recovered from mobile devices to extrapolate relationships among people and the strength and quality of the relationship (parent-child, friends, weak, strong). As such, the paper exemplifies the relationship between social networks and the social media as well as the pervasive geocoding of information and the ability to represent relationships spatially. Computational technology and social media are closely aligned with—but not identical to—the utility of the network model, a core notion in a series of papers that allows for complexity, multiple scales, and integration of analyses from many disciplines in the social and natural sciences (Cutcher-Gershenfeld; Pentland; Pescosolido). In addition to the questions that arise from the social media specifically, and technology more generally (Arndt; Berube; Neuby; Scholl; Yuan), is a set of papers that employ the power of computational technology to model network relationships that may or may not be visible—or not visible at scale—using other means. Indeed, authors used the network abstraction to model or to postulate models over a broad range of phenomena including: neuroscience (Levine169); small businesses (Cunningham); technology development, specialization, and collaboration (Blankenship; Janoski); economics and decision making (Jackson); contagion effects, market robustness, fragility, and collapse (Blume); and—perhaps most ambitiously—human systems over the last 600 years (Owens).

Papers that address social networking, technology, and new media embody a data-intensive, multidisciplinary, and collaborative approach seen in many of the white papers. These topics span the SBE sciences and many reach out to other parts of the Foundation. The approach seems particularly well-suited to the challenges Americans face at home and abroad in the environment and in our towns, cities and schools as we prepare for a competitive yet inter-dependent global future. Clearly the network model is not the only solution; it does appear to be a promising place to start.

MAKING SENSE OF THE COLLECTION: NEXT STEPS

The collection of white papers is both a single intellectual entity—a set of responses to three questions that are intended to help us think about the NSF/SBE program on a decadal scale—and 252 individual intellectual objects, each embodying a thoughtful and coherent statement about next generation SBE science. In this chapter, we have focused on the attributes of the collection: seen as one statement about the future, what does it tell us? Collectively, the papers point to next generation SBE research that is data intensive, multidisciplinary, mediated by technology, collaborative, and problem focused. That type of research is likely to exploit new kinds and sources of data and to present theoretical and methodological challenges, which are also the focus of research, particularly research related to statistics, sampling, and experiment design. Finally, four crosscutting themes: population change; disparities; communication, language, and linguistics; networks and social media offer promising avenues. All four attract substantial interest, are not well served within the existing structure of the directorate, and have the potential to support cross-fertilization of ideas. These findings make sense from the perspective of NSF/SBE's program. Chapter 3 discusses actions that could be taken based on those findings.

These are first, not last, words. The collection of white papers is a resource for the research community; it invites more study and use.

By forging links between fundamental research and society's needs, NSF helps articulate important new areas of S&E [science and engineering], improves quality of life, creates a scientifically literate populace, and empowers future generations. NSF is committed to creating connections between research produced through our investments and the needs of society.

Empowering the Nation through Discovery and Innovation
NSF Strategic Plan for Fiscal Years (FY) 2011-2016, page 10

3 NEXT GENERATION SBE SCIENCE: GETTING THERE FROM HERE

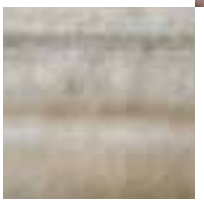
SBE 2020 is a visioning and a programmatic exercise. With a few minimal constraints, NSF/SBE encouraged members of the community to describe how they envisage research on a decadal scale and to do so in a fashion that would help the SBE directorate manage its programs in creative and transformative ways. This means both listening to the community—hence the white papers and the consultation—as well as some self-reflection within the directorate. Based on this experience, is the structure of the SBE directorate, its divisions, offices, and programs, sufficient to sustain next generation research? How well does the directorate, in fact, support the social and behavioral research enterprise? This final chapter lays out a strategy for translating what was heard into actions. The proposed path forward is, frankly, incremental, allowing different divisions of the directorate to assess the merits of suggested approaches and to modify priorities or adopt new programs as appropriate while allowing for continued consultation with the community.

On the one hand, existing programs and interests within the SBE directorate meet fundamental intellectual needs. The record over the past 20 years speaks unambiguously to that achievement, and none of the papers, even the ones calling most stridently for multi-disciplinary research, told the Foundation to cancel core disciplinary programs in the SBE sciences. Several authors, though, cautioned about the perils of embracing multidisciplinary research at the expense of the core SBE sciences (Boskin). Indeed, multidisciplinary research rests on a grounding in them. But the papers also conveyed impatience and, perhaps given the nature of the project, they were full of ideas about expanding on the base of existing programs to try new and different strategies to address interesting new challenges.

Post-graduate education and professional experience teach those who conduct research and who make decisions about scientific policy to probe assumptions, parse questions, and drill down into the evidence. Does it really say what it seems to say? Are there extenuating circumstances? Is the experiment properly designed? What is the sampling strategy? When is a detail just a detail, and when does a detail signal something that bears closer examination? So it becomes very easy—and valuable—to burrow into topics, achieving ever finer degrees of refinement. The entirety of the experience—reading the white papers, discussing them with colleagues, and listening to a range of SBE scientists—evokes an image of scientists who are highly engaged with the fundamental problems, fascinated by the big and deceptively simple questions, eager to undertake interdisciplinary research and training, and much less focused on disciplinary science, for its own sake, even though young faculty are aware of the expectations and limitations of the traditional career path.

Many young SBE scientists come to the social sciences by way of concrete life experiences that enable them to see a larger picture through an immediate social or economic problem. Students and young faculty at UT-San Antonio, for example, talked passionately about housing, border cultures, extended families, urban infrastructure, financing, and water systems. This problem-focused perspective is not limited to the young. Well-established economists described research questions that stem from problems in fiscal policy, public goods, and global interdependence as well as the recent financial crisis. Global climate change has exposed and endangered high altitude archaeological sites (Adams), and globalization has resulted in the rapid demise of spoken languages. Senior scholars in linguistics addressed the implications of the loss of linguistic diversity, the importance of documenting endangered languages, and the need to build a global database of linguistic information. Such activities preserve the record






(if not the language), advancing the study of the brain as well as the basic science of linguistics, which has direct application to cross-language computational tools vital to a globalized future (Bender; Campbell; Goldsmith; Wasow). In the papers and in our conversations on campus, respondents repeatedly asked us to recognize the advantages of examining fundamental research questions through the study of immediate problems such as housing, urban redevelopment, health disparities, and gang membership *and also* to encourage ideas at the boundaries of existing disciplines, to help them find ways to collaborate with others and learn new skills, and, in the words of a young faculty member at UC-Berkeley, to "embrace change; break the guild."

Encouraging curiosity-driven researchers to pursue their ideas in a rigorous and scientifically responsible way within and across traditional boundaries will stimulate creative new science.

This vision of research—innovative, multidisciplinary, collaborative, and problem focused—stands in contrast to an academic world still dominated by disciplinary structures and frankly a National Science Foundation that is organized along disciplinary lines. Therein lies a contradiction: a growing number of scientists committed to experimenting with new ways to solve problems and do research stand alongside established disciplinary structures that have substantial value but can also be rigid and uncompromising. How does NSF plan for a 21st-century future in the face of this contradiction? How does it move from the industrial age structures of the past 60 years to the information age flexibility that many creative scientists embrace?

DECADAL GOALS AND STRATEGIES

The research community, including senior scholars, recently tenured faculty, and graduate students, has communicated clearly its ideas about the broad contours of future research:

- Support new approaches to fundamental questions, including interdisciplinary research within the SBE sciences and across traditional divisions to reach out to biology, ecology, computer science, and engineering (among others).
- Help scientists form collaborative teams and find ways to enable continuing training in new techniques and methods.
- Provide the infrastructure of data, services, and programs to enable computationally intensive, data-rich investigations, scenario- and model-building, and integrated multidisciplinary investigations.

The next steps for the SBE directorate involve translating these scientific research objectives into actions through which they can be achieved. For the directorate, that means a series of near- and long-term activities. One possible configuration of activities is summarized *(See table page 31)*. This proposed strategy combines ongoing consultation with the research communities with some

Graduate students at UT-San Antonio: Carlos Valenzuela, Demography; Brenda Garza, Public Policy; Anna Lopez, Counseling; and Beatrix Perez, Sociology

OVERVIEW OF NSF/SBE PROGRAMMATIC GOALS, OBJECTIVES, AND SUGGESTED ACTIVITIES			
SBE 2020 PRIORITY AREA	SBE COMMUNITY GOALS	SBE DECADAL OBJECTIVES	SBE ACTIVITIES (1-3 YEARS)
Content of science	Examine new approaches and pursue fundamental questions	Establish priorities in existing programs Consider new programs, crosscutting activities within the directorate and across the Foundation and other agencies	Convene workshops and expert groups to plan for next generation science in specific areas Enhance mechanisms for interdisciplinary proposal review and budgets for interdisciplinary research
Capacity building	Form collaborations	Ways to enable team building and cross- disciplinary research	Improve SBE's investment in interdisciplinary training
Infrastructure	Access data, services, and program	Invest in data and data access; centers, enclaves, and trials	Build community plans for new data activities

immediate actions that would leverage existing programs and resources while more focused planning activities are underway.

As this program develops, NSF/SBE will consider entering into partnerships with directorates and offices within NSF and with other agencies and sponsors in the United States and in other countries. Encouraging curiosity-driven researchers to pursue their ideas in a rigorous and scientifically responsible way within and across traditional boundaries will stimulate creative new science. Good ideas know no boundaries, and in a future with constrained resources and expanding global challenges, intellectual isolationism—within disciplines, programs, and nations—inhibits good science that could yield great rewards for our citizens.

The underlying balance and symbiosis between foundational work in the existing NSF/SBE programs and new initiatives that reflect emerging interests call initially for an incremental approach in which the SBE directorate maintains what it does well, plans for possible new programs to address opportunities and gaps and to support crosscutting themes and topics, and takes on the hard problem of streamlining, merging, and sunsetting programs. Achieving these goals calls for actions on the part of the NSF/SBE staff, continued advice and consultation with the Advisory Committee for the Social, Behavioral and Economic Sciences, and ongoing engagement with others, both inside and outside the university-based research community.

WHAT TO EXPECT IN 2012–2015

NSF/SBE will move its actions and consultations forward on three parallel tracks: refining priorities for the content of SBE science; exploring ways to develop the capacity to conduct this work; and advancing the infrastructure of services, facilities, and data that forms the platform from which the science can be undertaken.

Content of Science

The responses of the Committee on Institutional Cooperation and others mentioned in Chapter 1 illustrate ways that the white papers constitute an intellectual framework for future work. They outline rich research agendas in several areas, economics, linguistics, and psychology being the most obvious examples. Within the SBE directorate, program officers, division leadership, and members of the advisory committee are encouraged to mine the papers and to use them as points of departure for setting priorities within the existing programs. At the same time, NSF/SBE should continue to assess the material and to identify gaps and omissions across and within fields.

Consequently and in parallel with deliberations internal to the directorate, NSF/SBE will engage a range of researchers in a series of conferences and workshops around the topic of new approaches and fundamental research questions and to consider the implications of these ongoing interactions for the directorate's programs. These conferences will proceed along two tracks: substance of the science and programmatic structure. The four priority areas (population change, disparities, language, and technology/new media) are places to start, but are not the final word. NSF/SBE will explore convening expert groups to drill down into one or more of these topics to articulate the driving questions, describe possible approaches, outline needs, and determine whether there is truly a community of interest behind the ideas. At the same time, NSF/SBE will continue discussing broader strategic approaches with

the Advisory Committee and others, with a view toward keeping its programmatic focus on intermediate and long-term planning.

Imagining new initiatives is always exciting, but the results must balance innovation and stability. Change has value, but so does predictability. This balance speaks both to the needs of the research community as well as to the interests of the Foundation and the directorate. In practical terms, investigators need at least a year to build successful proposals and also require some reasonable assurance that a program will survive 5 to 10 years before putting institutional resources behind a venture. Similarly, the Foundation and the directorate need a sense of the research potential and the commitment of the investigators before launching a new multi-year program. Independent of the SBE 2020 visioning exercise, NSF/SBE program officers have already initiated such community-based discussions about the future of their sciences; relevant information is presented in Appendix 6. The workshops proposed for the next two to three years should be built on these models and should take advantage of these findings in relevant areas, notably brain and behavior, forensics, decision making, and law and society.

Building Capacity

In the white papers themselves, topics related to training and building capacity tended to be acknowledged but less well developed than discussions of driving scientific questions and infrastructure. Yet in conversations surrounding the papers, training by far excites the most interest. Perhaps the absence of a well-formed consensus beyond an acknowledged need to know more is the most interesting finding. NSF does have a set of mechanisms for assisting undergraduates, graduate students, and young faculty, but these do not address the needs of mid-career faculty. Moreover, it is unclear whether training should be a feature of a larger effort, such as a synthesis center (Hackett), focused on challenges specific to interdisciplinary research (Bosque-Perez), or tied to understanding the use of certain kinds of resources (for example, genetic data, fMRI techniques and interpretation, statistical data). Summer programs and internships are also traditional mechanisms but venturing beyond the traditional SBE methodologies, such as statistics, has been problematic. Anecdotal information suggests that SBE scientists who do learn new methods and tools in, for example, epigenetics, have happened on a sympathetic colleague or mentor who provided time in a genetics lab. These approaches do not scale. Systematic ways to make them more widespread, accessible, and predictable should be articulated along with NSF/SBE's role in fostering and institutionalizing them.

Education and training activities are frequently appended as well-intentioned elements of a larger plan. The level of interest in training suggests that NSF/SBE should elevate capacity building to a high priority. While the directorate in concert with other entities within the Foundation examines how existing mechanisms might be leveraged in the near term, NSF/SBE anticipates organizing efforts with the community and with the help of the SBE Advisory Committee to articulate a more formal set of steps and then to launch a series of pilot activities to test different approaches over the next one to four years.

Infrastructure and Data

The enthusiasm for data is obvious, so much so that some authors seem to have felt compelled to argue the case for theory (for example, Duflo; Lee). NSF/SBE's role is coordinative: to encourage articulation and adoption of best practices and standards; assist in the use of new, sensitive, and non-traditional forms of data; and to support training in appropriate use and management of data, analytical methods, and sound data management policies. In the past year, NSF/SBE has supported and hosted two major workshops on data and data infrastructure (Appendix 6), and the directorate expects to proceed with actions based on their recommendations.

Less obvious is the role NSF/SBE might play in organizing new surveys and datasets, for example, the panel study proposed by Moffitt or the collections of linguistic data described by Campbell, Crane, Pye, and others. As part of the planning associated with the priority areas, NSF/SBE will encourage rigorous discussion of the need for such datasets, their technical requirements, and the science that these community resources might support. Indeed, several strategies are possible. In some areas, particularly where single investigator/small-team research is the norm, approaches that emphasize appropriate data management policies to enable

future discovery and reuse might be more appropriate than attempting to mount a very large data effort that would become a long-lived collection used by many researchers.

These are questions that only the community can answer. Therefore, the directorate anticipates organizing a series of planning grants and pilot studies both to test the level of interest in the community around a given topic as well as the proposed technical and data infrastructure. As the conversations continue, then, plans will become more focused, concrete and, eventually, actionable. Continuing to welcome advice and input from the research community is important. But the research community will not be well served, if the directorate does not also take steps to begin to build infrastructure, deepen capacity, and transform SBE science.

A FEW FINAL OBSERVATIONS

Doing the SBE 2020 project opened a window into SBE science that shows its underlying unity as well as its rich diversity. The experience of analyzing the white papers and discussing them with many colleagues laid bare a tension between *characterizing* the research process as distinct from findings that result from *doing* the science. In the white papers, this tension was manifested by discussions of method and theory or evidence and multidisciplinarity versus the rich potentials of studying brain and behavior, population, technology, or education and health disparities. The duality was always present. Of course experiment design and method are intrinsic to all science. The approach taken by this project—controlled crowdsourcing with a relatively open call to participation, coupled with targeted consultation—places this relationship and the attributes of our contemporary, data- and computationally-intensive research environment at the center of the exercise.

Of the many lessons that can be drawn from this experience, the one that may be most important as the planning and pilot projects go forward speaks to the promise of broad collaboration, perhaps with unanticipated partners and unforeseen consequences. The notion of the unexpected, whether of the diversity in the background of white paper authors or of the variety of the SBE science they imagined, intrigues us. The Foundation seeks to transform the frontier, an image of the future rooted in the agency's beginnings in Vannevar Bush's report to the President. The notion of a frontier evokes images of the unexplored. This report lays out ways to render that unexplored terrain more tractable. Future work will expand upon these traces and, like others before us, will push back the frontiers of knowledge.

APPENDIX 1:
DISTRIBUTION BY COUNTRY AND STATE (U.S.)

INTERNATIONAL REPRESENTATION

COUNTRY AS REPORTED BY CORRESPONDING AUTHOR	NUMBER OF PAPERS
France	1
Portugal	1
Canada	2
Israel	3
United Kingdom	4
United States	241

Source: *As reported on http://www.nsf.gov/sbe/sbe_2020/all.cfm.*

REPRESENTATION OF STATES AND TERRITORIES IN THE U.S.

The Experimental Program to Stimulate Competitive Research (EPSCoR) at the National Science Foundation assists the Foundation in its statutory function "to strengthen research and education in science and engineering throughout the United States and to avoid undue concentration of such research and education" (http://www.nsf.gov/od/oia/programs/epscor/about.jsp). There are 29 EPSCoR jurisdictions; 17 are represented (Column 3).

STATE	N OF PAPERS	EPSCOR
California	31	
Massachusetts	24	
Illinois	22	
New York	15	
Arizona	13	
Texas	13	
Pennsylvania	12	
District of Columbia	9	
Connecticut	8	
Virginia	8	
Florida	7	
Maryland	7	
Michigan	7	
Ohio	6	
Georgia	5	
Missouri	5	
New Jersey	5	
Oklahoma	5	Yes
Colorado	4	
Indiana	3	

STATE	N OF PAPERS	EPSCOR
Iowa	3	Yes
North Carolina	3	
Tennessee	3	Yes
Washington	3	
Idaho	2	Yes
South Carolina	2	Yes
Wisconsin	2	
Hawaii	1	Yes
Kansas	1	Yes
Kentucky	1	Yes
Louisiana	1	Yes
Minnesota	1	
Mississippi	1	Yes
Montana	1	Yes
Nebraska	1	Yes
New Mexico	1	Yes
Oregon	1	
South Dakota	1	Yes
Utah	1	Yes
Vermont	1	Yes
Wyoming	1	Yes

APPENDIX 2:

DISTRIBUTION BY HOME INSTITUTIONS BASED ON AFFILIATION OF CORRESPONDING AUTHOR

The affiliations are self-reported by the corresponding author.

NAME OF INSTITUTION	N OF PAPERS
Harvard University	10
University of Illinois	10
Massachusetts Institute of Technology	7
Arizona State University	6
Stanford University	6
University of Chicago	6
University of California, Santa Barbara	5
Yale University	5
University of Maryland	4
University of Texas at Austin	4
University of Virginia	4
Florida State University	3
Haskins Laboratories	3
Ohio State University	3
Texas Tech University	3
University of Arizona	3
University of California, Berkeley	3
University of Colorado at Boulder	3
University of Michigan	3
University of Pennsylvania	3
Washington University in St. Louis	3
Binghamton University	2
Cornell University	2
George Mason University	2
Indiana University	2
Iowa State University	2
Johns Hopkins University	2
Michigan State University	2
Northern Arizona University	2
Northwestern University	2
Pennsylvania State University	2
RAND Corporation	2
Rensselaer Polytechnic Institute	2
SRI International	2
State University of New York—Albany	2
University of California, San Diego	2
University of Cincinnati	2
University of Georgia	2

NAME OF INSTITUTION	N OF PAPERS
University of Illinois at Urbana-Champaign	2
University of Massachusetts, Amherst	2
University of Oklahoma	2
University of Pittsburgh	2
University of Tennessee	2
University of Washington	2
University of Wisconsin-Madison	2
American Political Science Association	1
Augustana College	1
Bank of Israel	1
Bryn Mawr College	1
California State University, East Bay	1
California State University, Northridge	1
Carnegie Mellon University	1
Center for Desert Archaeology	1
Choctaw Nation of Oklahoma	1
City University of New York	1
CNA Corporation	1
College of Charleston	1
Colorado State University	1
Columbia University	1
Columbia University Business School	1
Dalhousie University	1
Drexel University	1
Duke University	1
Duval County Health Department and University of Florida College of Medicine	1
East Carolina University	1
Eastern Michigan University	1
Ecological Society of America	1
Emory University	1
ESSEC Business School	1
Fairleigh Dickinson University	1
Florida International University	1
George Washington University	1
Georgetown University	1
Georgia Institute of Technology	1
Google	1

NAME OF INSTITUTION	N OF PAPERS
Government Statistician, Israel and The Hebrew University	1
Grandfather	1
Harvard University and NBER	1
Hoover Institution	1
Hunter College of the City University of New York	1
Idaho State University	1
Illinois Mathematics and Science Academy	1
JLM Mediation Service	1
Kennesaw State University	1
Lancaster University	1
LivingCapitalMetrics.com	1
London School of Economics	1
Los Alamos National Laboratory	1
Louisiana State University	1
Metadata Technology North America	1
Mississippi College	1
Missouri Botanical Garden	1
Massachusetts Institute of Technology	1
MIT and NBER	1
Mount Sinai School of Medicine	1
National Communication Association	1
National Institute for Occupational Safety and Health	1
North Carolina State University	1
Ocean Education, Technology and Sciences Parternship	1
Open Data Foundation	1
Population Association of America/Association of Population Centers	1
Princeton University	1
Ramapo College of New Jersey	1
Rutgers, the State University of New Jersey	1
San Jose State University	1
Santa Fe Institute	1
State University of New York at Stony Brook	1
Technical University of Lisbon	1
Tel Aviv University	1
Texas State University-San Marcos	1
The Hilltop Institute	1
Pennsylvania State University	1
Tufts University	1

NAME OF INSTITUTION	N OF PAPERS
U. S. Air Force, OO-ALC, Hill AFB	1
University at Buffalo—SUNY	1
University Consortium for Geographic Information Science	1
University of California at Davis	1
University of California, Riverside	1
University of California, Santa Cruz	1
University of Florida	1
University of Hawaii	1
University of Houston	1
University of Idaho	1
University of Illinois at Chicago	1
University of Iowa	1
University of Kansas	1
University of Kentucky	1
University of Massachusetts Boston	1
University of Miami	1
University of Minnesota	1
University of Missouri	1
University of Nebraska-Lincoln	1
University of North Texas	1
University of Notre Dame	1
University of Oklahoma Health Sciences Center	2
University of Portsmouth	1
University of South Carolina	1
University of Southern California	1
University of Texas at Arlington	1
University of Texas at San Antonio	1
University of Texas Health Science Center at San Antonio	1
University of Vermont	1
University of Warwick	1
University of Wyoming	1
US Census Bureau	1
Veridical Research and Design	1
Villanova University	1
Virginia Tech	1
Wayne State University	1
Woodrow Wilson International Center for Scholars	1
York University	1
TOTAL	252

APPENDIX 3:

DISTRIBUTION BY UNIT/DEPARTMENT BASED ON AFFILIATION OF CORRESPONDING AUTHOR

Two hundred fourteen corresponding authors provided affiliations at the department or unit level below the level of university or college as reported by the corresponding authors. Of these, 119 (56 percent) are in economics, psychology, political sciences and public policy, sociology, linguistics, education, health sciences, communication, and geography. All 214 in descending order are presented below.

DEPARTMENT/UNIT	N
Economics	28
Psychology	17
Political Science and Public Policy	15
Sociology	15
Linguistics	10
Education	9
Anthropology	8
Health Sciences	7
Communication	6
Geography	4
School of Library and Information Studies	3
Center for Technology in Learning	2
Community and Regional Planning Program	2
Dean's Office	2
Department of History	2
History	2
John F. Kennedy School of Government	2
School of Human Evolution & Social Change	2
Science and Technology Studies	2
309 SMXG, Software Maintenance Group	1
Arizona State Museum	1
Bioengineering & Systems Science and Industrial Engineering	1
Booth School of Business	1
Brain and Cognitive Sciences	1

DEPARTMENT/UNIT	N
Center for Collective Intelligence	1
Center for Financial Security	1
Center for Health Outcomes & Policy Research	1
Center for Mind and Brain	1
Center for Public Administration and Policy	1
Center for Studies in Higher Education	1
Center for Survey Research & Department of Sociology	1
Center for Technology in Government	1
Center for the Study of Standards in Society	1
Centre for Economic Performance	1
Classics and Computer Science	1
Cognitive Science Department	1
College of Graduate Studies	1
Community and Regional Planning Program and the Environmental Science Institute	1
Complex Systems	1
Computer Science	1
Construction Engineering	1
Criminal Justice	1
Department of Criminology and Criminal Justice	1
Department of Educational Policy Studies	1
Department of Family and Consumer Sciences	1
Department of Human Relations	1
Departments of Biology and Anthropology	1
Departments of Economics and Information Science	1

DEPARTMENT/UNIT	N
Division of Social Sciences	1
East Asian Languages and Cultures, Linguistics	1
Edward J. Bloustein School of Planning and Public Policy	1
Eli Broad College of Business	1
ENV-ES Environmental Stewardship Group	1
Global Sociocultural Studies	1
Governor	1
Graduate School of Social Work and Social Research	1
Haas School of Business	1
Human Development and Family Studies	1
Human-Computer Interaction Institute	1
Industrial Engineering	1
Institute for Computing in Humanities, Arts, and Social Science	1
Institute for Employment Research	1
Institute for Language Information and Technology	1
Institute for Research in the Social Sciences	1
Institute for Social Research	1
Institute of Behavioral Science	1
Interdisciplinary Health Policy Institute	1
IROM	1
Kellogg School of Management	1
Labor and Population	1
Linguistics, Computer Science, and Beckman Institute	1
Management Department	1

DEPARTMENT/UNIT	N
Maryland Population Research Center	1
Mathematics department	1
Management Information Systems Department	1
Museum of Art and Archaeology	1
Natural Resources Ecology Laboratory	1
National Opinion Research Center	1
Office of Institutional Research	1
Penn Cultural Heritage Center	1
Population Research Institute	1
Psychology, Anthropology	1
Research Management Office	1
Scholarly Communication Office, W.E.B. Du Bois Library	1
School of Human Evolution & Social Change/Center for Social Dynamics & Complexity	1
School of Human Evolution and Social Change	1
School of Labor and Employment Relations	1
School of Life Sciences	1
Sloan School of Management	1
Social Science and Human Services	1
Stanford University	1
Statistical Research Division	1
Tribal Research	1
United States Studies	1
Yerkes National Primate Research Center	1
TOTAL	214

(Not all corresponding authors reported this level of affiliation.)

APPENDIX 4:
DISTRIBUTION OF WHITE PAPERS BY FIELD OF STUDY

The National Center for Science and Engineering Statistics provided a simple taxonomy of fields of study, which was used to identify papers. Each paper was assigned to only one field of study as distinct from the keyword analysis (Appendix 5) in which up to three keywords were assigned to each paper. This appendix provides the cumulative frequency distribution for all fields of study represented in the collection (Table 4.1). A second cumulative frequency distribution (Table 4.2) in which several closely related fields of study were grouped together is also presented.

TABLE 4.1 CUMULATIVE FREQUENCY DISTRIBUTION BY FIELD OF STUDY

FIELD OF STUDY	N	%	CUMULATIVE
social sciences, general	44	17.5%	17.5%
economics	39	15.5%	32.9%
sociology	17	6.7%	39.7%
education	16	6.3%	46.0%
linguistics	14	5.6%	51.6%
psychology	13	5.2%	56.7%
anthropology/archaeology	12	4.8%	61.5%
political science and government	12	4.8%	66.3%
health sciences	10	4.0%	70.2%
communication	9	3.6%	73.8%
computer and information science	9	3.6%	77.4%
geography	8	3.2%	80.6%
public policy analysis	8	3.2%	83.7%
cognitive psychology	6	2.4%	86.1%
demography	6	2.4%	88.5%
biological/biomedical sciences	5	2.0%	90.5%
urban affairs/studies	4	1.6%	92.1%
engineering	3	1.2%	93.3%
industrial and organizational psychology	3	1.2%	94.4%
statistics	3	1.2%	95.6%
criminology	2	0.8%	96.4%
mathematics	2	0.8%	97.2%
atmospheric science and meteorology	1	0.4%	97.6%
business management/administration	1	0.4%	98.0%
humanities	1	0.4%	98.4%
international relations/affairs	1	0.4%	98.8%
public administration	1	0.4%	99.2%
teacher education	1	0.4%	99.6%
NA	1	0.4%	100.0%
FIELD OF STUDY VALUE GRAND TOTAL SUM:	252		

TABLE 4.2 CUMULATIVE FREQUENCY DISTRIBUTION WITH AGGREGATED FIELDS

Political science has been expanded to include government, policy, and international relations; and psychology has been expanded to include cognitive psychology and industrial psychology.

FIELD OF STUDY	N	%	CUMULATIVE
social sciences, general	44	17.5%	17.5%
economics	39	15.5%	32.9%
communication and linguistics	23	9.1%	42.1%
psychology	22	8.7%	50.8%
political science	21	8.3%	59.1%
sociology (incl. criminology)	19	7.5%	66.7%
education/teacher education	17	6.7%	73.4%
anthropology/archaeology	12	4.8%	78.2%
geography/urban studies	12	4.8%	82.9%
health sciences	10	4.0%	86.9%
computer and information science	9	3.6%	90.5%
demography	6	2.4%	92.9%
biology/biomedical sciences	5	2.0%	94.8%
mathematics and statistics	5	2.0%	96.8%
engineering	3	1.2%	98.0%
atmospheric science and meteorology	1	0.4%	98.4%
business management/administration	1	0.4%	98.8%
humanities	1	0.4%	99.2%
NA	1	0.4%	99.6%
public administration	1	0.4%	100.0%
FIELD OF STUDY VALUE GRAND TOTAL SUM:	252		

APPENDIX 5.

WHITE PAPERS BY CORRESPONDING AUTHOR WITH WHITE PAPER ID, FIELD OF STUDY, AND KEYWORDS

Each successfully uploaded white paper was assigned a unique identifier (ID) by the system, which enabled us to maintain version control within the collection of papers. Authors were allowed to resubmit corrected versions of their papers within the submittal period. Resubmitted papers were assigned new unique IDs. Thus, the ID is only meaningful from the perspective of the system and for maintaining version control. The National Center for Science and Engineering Statistics provided a simple taxonomy of fields of study, which was used to identify papers. Each paper was assigned to only one field of study as distinct from the keywords. Using keywords, rather than terms in a thesaurus or ontology, is a less formal way to probe the content of the papers, similar to tagging. Although the advantages of a controlled vocabulary are lost, the informality of the approach allowed flexibility in characterizing the content of papers without the intermediating and homogenizing effects of external methods for cataloging and description.

WHITE PAPER	AUTHOR	FIELD OF STUDY	KEYWORD (1)	KEYWORD (2)	INTERDISCIPLINARY
88	Acemoglu, Daron Department of Economics Massachusetts Institute of Technology MA, U.S.	Challenges for Social Sciences: Institutions and Economic Development			
		economics	institutions	economic development	yes
139	Adamick, Jessica Scholarly Communication Office, W.E.B. Du Bois Library University of Massachusetts, Amherst MA, U.S.	Advancing Ethical Research Across Disciplines			
		social sciences, general	research ethics	technology	
270	Adams, Rich University of Wyoming WY, U.S.	Future Considerations for Archaeology at Altitude			
		anthropology	alpine sites	climate change	
45	Alesina, Alberto Department of Economics Harvard University MA, U.S.	Pushing the Boundaries of Economics			
		economics	international	comparative	yes
124	Altonji, Joseph G. Department of Economics Yale University CT, U.S.	Multiple Skills, Multiple Types of Education, and the Labor Market: A Research Agenda			
		economics	education and training	labor market	
229	Aristar, Anthony Institute for Language Information and Technology Eastern Michigan University MI, U.S.	Endangered Languages and Linguistic Infrastructure			
		linguistics	endangered languages	preservation/ recordation	
214	Arndt, Angela E. Educational Studies University of Cincinnati OH, U.S.	Where They Live: Community Media Centers as Hubs for Building Technological Literacy, Media Literacy, and Active Citizenship			
		education	public participation		
180	Aron, Arthur Department of Psychology State University of New York at Stony Brook NY, U.S.	How and Why Do Close Relationships Shape Human Behavior?			
		psychology	close relationships		
98	Autor, David H. Department of Economics Massachusetts Institute of Technology MA, U.S.	Grand Challenges in the Study of Employment and Technological Change			
		economics	education	labor	

WHITE PAPER	AUTHOR	FIELD OF STUDY	KEYWORD (1)	KEYWORD (2)	INTERDISCIPLINARY
255	Bach, Betsy National Communication Association DC, U.S.	National Communication's Response to Dear Colleague Letter			
		communication	science communication		
161	Barker, Alex W. Museum of Art and Archaeology University of Missouri MO, U.S.	Documenting Extant Cultural Collections: A Grand Challenge for the Social Sciences			
		anthropology	collections management	data reuse	
61	Baron, J. Department of Psychology University of Pennsylvania PA, U.S.	Comments on Grand Challenges			
		psychology	decision making	civic life	
272	Barton, C. Michael School of Human Evolution & Social Change/Center for Social Dynamics & Complexity Arizona State University AZ, U.S.	SBE 2020: Twenty-First Century Challenges and Opportunities for the Human Sciences			
		social sciences, general	disciplinary sciences	collaboration	
39	Barzilai, Jonathan Industrial Engineering Dalhousie University Canada	Correcting the Mathematical Foundations of the Social & Economic Sciences			
		mathematics	models	global approach	
81	Bender, Emily M. Department of Linguistics University of Washington WA, U.S.	A Grand Challenge for Linguistics: Scaling Up and Integrating Models			
		linguistics	models	risk	
281	Berry, Steven T. Department of Economics Yale University CT, U.S.	A Proposal for Future SBE/NSF Funding: Refocusing Microeconomic Policy Research			
		economics	public policy		
75	Berube, David M. Communication/Public Communication of Science and Technology Project North Carolina State University NC, U.S.	Researching Social Media in the 21st Century			
		communication	social media	epidemiology	
250	Bhatt, Rakesh M. Department of Linguistics University of Illinois IL, U.S.	Migration, Multilingualism, and Minorities: New Challenges for the Linguistic Sciences			
		linguistics	language and culture	migration	
142	Bjerk, Paul K. Department of History Texas Tech University TX, U.S.	Melding Milk and Iron: The Affective Power of Pre-Colonial Science in Post-Colonial Africa			
		political science and government	communication	transnational research	
233	Blankenship, Kevin Department of Psychology Iowa State University IA, U.S.	Social Technical Congruence: The Link Between Social Science and Technology			
		communication	collaboration	product design	
123	Bloom, Nicholas Department of Economics Stanford University CA, U.S.	White Paper for NSF Grand Challenges			
		economics	public policy	translational research	
162	Blume, Lawrence E. Departments of Economics and Information Science Cornell University NY, U.S.	Robustness and Fragility of Markets: Research at the Interface of Economics and Computer Science			
		economics	markets	public policy	

APPENDIX 5 CONTINUED

WHITE PAPER	AUTHOR	FIELD OF STUDY	KEYWORD (1)	KEYWORD (2)	INTERDISCIPLINARY
95	Bohnemeyer, Juergen Department of Linguistics University at Buffalo—SUNY NY, U.S.	Semantic Typology as an Approach to Mapping the Nature-Nurture Divide in Cognition			
		linguistics	nature/nuture		
207	Boker, Steven M. Department of Psychology University of Virginia VA, U.S.	SBE 2020: Quantitative Convergence of Lifespan Development, Neuroimaging, and Genetic Epidemiology			
		psychology	lifespan	neuroimaging	yes
129	Bongard, Josh Computer Science University of Vermont VT, U.S.	Complex, Heterogeneous Teams Solving 21st Century Problems			
		computer and information science	collaboration	decision-making	
220	Bonito, Joseph A. Department of Communication University of Arizona AZ, U.S.	The Grand Challenge of Understanding Group Effectiveness			
		sociology	group formation	collaboration	
308	Börner, Katy School of Library and Information Science Indiana University IN, U.S.	The Science of Team Science (SciTS): A Beacon for 21st Century Scientific Collaboration			
		social sciences, general	collaboration		
58	Boskin, Michael J. Economics and Hoover Institution Stanford University CA, U.S.	Future NSF Economics Funding Priorities			
		economics	theory	evolutionary science	
86	Bosque-Perez, Nilsa College of Graduate Studies University of Idaho ID, U.S.	Teaching and Evaluation of Interdisciplinarity			
		social sciences, general	interdisciplinarity		yes
136	Bowser, Benjamin P. Department of Sociology and Social Services California State University, East Bay CA, U.S.	Expanding Multivariate Models			
		social sciences, general	data	global	
29	Boyer, Pascal R. Psychology, Anthropology Washington University in St. Louis MO, U.S.	Integrated Social Science: Exploring the Dark Matter of Human Cultures and Societies			
		anthropology	culture	norms	yes
188	Braden, John B. Department of Agricultural & Consumer Economics University of Illinois IL, U.S.	Coupling Human System Data with Natural System Data: Laying a Foundation for Sustainability Science			
		biological/ biomedical sciences	ecology	environment	
191	Brady, Henry E. American Political Science Association DC, U.S.	Improving Measures of Democracy and Governance			
		political science and government	indicators	global governance and democracy	
240	Broadbent, Jeffrey P. Sociology Department University of Minnesota MN, U.S.	Social and Political Dynamics under Intensifying Climate Change: Proposal for a Long-Term Data Collection Project			
		sociology	decision making	scale	

WHITE PAPER	AUTHOR	FIELD OF STUDY	KEYWORD (1)	KEYWORD (2)	INTERDISCIPLINARY
76	Brooks Carthon, J. Margo Center for Health Outcomes & Policy Research University of Pennsylvania PA, U.S.	Beyond Despair: Next Decade Research Strategies to Promote Health Equity among Racial and Ethnic Minorities			
		health sciences	public health	mental health	yes
80	Brown, Michael F. Department of Psychology Villanova University PA, U.S.	What Can Animal Cognition Contribute to Cognitive Science?			
		psychology	cognition	animal studies	
74	Brown, Rex V. School of Public Policy George Mason University VA, U.S.	Prescriptive Decision Research: An Interdisciplinary Extension Of Normative And Descriptive Decision Theory Integrated With Decision Aiding Experience			
		public policy analysis	funding		
85	Buckwalter, Kathleen C. College of Nursing University of Iowa IA, U.S.	Knowledge Development for Mental Health of Older Adults			
		health sciences	public health		
90	Busch, Lawrence Center for the Study of Standards in Society Michigan State University MI, U.S.	Understanding Standards			
		political science and government	standards	governance	
153	Cacioppo, John T. Department of Psychology University of Chicago IL, U.S.	Identifying the Biological Mechanisms Underlying Social Behavior			
		psychology	brain	mediation	yes
82	Campbell, Lyle Department of Linguistics University of Hawaii HI, U.S.	Documentation and Analysis of Endangered Languages, Cultures, and Knowledge Systems			
		linguistics	endangered languages		
112	Card, David E. Department of Economics University of California, Berkeley CA, U.S.	Expanding Access to Administrative Data for Research in the United States			
		social sciences, general	administrative data	public policy	
119	Cardinale, John A. Education Department City University of New York NY, U.S.	Dirty Jobs: Fitting a Statistical Model to a Large Dataset with a Large Amount of Missing Data			
		social sciences, general	statistical methods	administrative data	
212	Cavarretta, Fabrice L. Management Department ESSEC Business School FR	The Management and Organization Science Puzzle: Questions from a Metaphorical Comparison of Medicine and Management			
		industrial and organizational psychology	scientific research	collaboration	
151	Chapin, F. Stuart Ecological Society of America DC, U.S.	Earth Stewardship: A Framework to Transform the Trajectory of Society's Relationship to the Biosphere			
		biology/biomedical sciences	perception	decision-making	yes
257	Charness, Gary University of California, Santa Barbara CA, U.S.	Prize good research!			
		NA	prizes		

APPENDIX 5 CONTINUED

WHITE PAPER	AUTHOR	FIELD OF STUDY	KEYWORD (1)	KEYWORD (2)	INTERDISCIPLINARY
297	Chilton, Elizabeth S. Anthropology University of Massachusetts, Amherst MA, U.S.	NSF White Paper: A Call for a Social Science of the Past			
		archaeology	cultural heritage		yes
72	Chodzko-Zajko, Wojtek Kinesiology and Community Health/ Applied Health Sciences/Center for Health, Aging, and Disability University of Illinois IL, U.S.	An Integrated Systems Approach to Building Healthy Communities			
		health sciences	public health	inequality	yes
305	Clark, Jeffery J. Center for Desert Archaeology AZ, U.S.	Predicting the Causes and Consequences of Human Migration			
		demography	migration	prediction	yes
273	Clough, Allison J. Interdisciplinary Health Policy Institute Northern Arizona University AZ, U.S.	The Relationship of American Values and Beliefs to 21st Century Health Practice and Health Care Policy			
		health sciences	obesity	diabetes	
40	Cohen, Deborah A. Health RAND Corporation CA, U.S.	How Can We Harness Marketing Strategies to Stem the Epidemics of Obesity and Dietary-Related Chronic Diseases?			
		health sciences	consumer behavior	dietary behavior	
260	Collins, J Michael Center for Financial Security University of Wisconsin-Madison WI, U.S.	Consumer Financial Behavior: Integrating Disciplines to Understand Fundamental Economic Activity at the Household Level			
		economics	consumer finance		yes
225	Cook, Karen S. Institute for Research in the Social Sciences Stanford University CA, U.S.	Providing the Web of Social Science Knowledge for the Future: A Network of Social Science Data Collaboratories			
		communication	information	collaboration	yes
163	Corrigan, John Religion; History Florida State University FL, U.S.	The Spatial Humanities: GIS and the Future of Humanities Scholarship			
		geography	GIS	scale	yes
137	Coulter, Bob Department of Education Missouri Botanical Garden MO, U.S.	Building Agency for Teachers and Students			
		education	agency		
216	Crane, Gregory R. Classics and Computer Science Tufts University MA, U.S.	Analyzing Human Systems across Time, Space, Language, and Culture			
		linguistics	cross language	machine translation	
301	Cresswell, Anthony M. State University of New York—Albany NY, U.S.	Information Technology: The Connective Tissue of Organizing			
		computer and information science	scale		
84	Cunningham, Thomas R. Education and Information Division National Institute for Occupational Safety and Health OH, U.S.	Workforce Protection in Small Businesses			
		business management/ administration	small business	social networks	

WHITE PAPER	AUTHOR	FIELD OF STUDY	KEYWORD (1)	KEYWORD (2)	INTERDISCIPLINARY
313	Cutcher-Gershenfeld, Joel School of Labor and Employment Relations University of Illinois at Urbana-Champaign IL, U.S.	Valuing the Commons: A Fundamental Challenge across Complex Systems			
		social sciences, general	political sciences		
34	Cutler, David M. Department of Economics Harvard University MA, U.S.	Why Don't People and Institutions Do What They Know They Should?			
		psychology	motivation	decision making	
278	Daniels, Brian I. Penn Cultural Heritage Center University of Pennsylvania PA, U.S.	The Importance of Cultural Heritage to Future Research in the Social, Behavioral, and Economic Sciences			
		anthropology	cultural heritage		
252	Darity, William A. Sanford Institute of Public Policy Duke University NC, U.S.	A Challenge For the National Science Foundation: Broadening Black and Hispanic Participation In Basic Economics Research			
		public policy analysis	diversity	scientists	
280	Denning, Kathryn E Anthropology York University Canada	Rethinking Life: Astrobiology and the Future of the Social, Behavioral, and Economic Sciences			
		anthropology	astronomy	extraterrestrial life	yes
15	Diamond, Peter Massachusetts Institute of Technology MA, U.S.	Three Research Themes			
		economics	behavioral economics	systemic risk	
285	Dickey, John W. Center for Public Administration and Policy Virginia Tech VA, U.S.	The Public Administration Genome Project			
		public administration	scale	organization	
87	Dolezal, Jake A. Tribal Research Choctaw Nation of Oklahoma OK, U.S.	New Paradigms in Native American Social and Behavioral Intervention Research			
		anthropology	method	sampling	
226	Dooling, Sarah Community and Regional Planning Program and the Environmental Science Institute University of Texas at Austin TX, U.S.	What About Social Equity: The Challenge to Urban Sustainability Planning			
		urban affairs/ studies	inequality		
309	Duflo, Esther Department of Economics Massachusetts Institute of Technology MA, U.S.	A Research Agenda for Development Economics			
		economics	economics		
30	Dwyer, Rachel E Sociology Department Ohio State University OH, U.S.	The Debt Society: College and Beyond			
		sociology	indebtedness	higher education	yes
181	Elias, Peter Institute for Employment Research University of Warwick UK	Future Research in the Social, Behavioural and Economic Sciences: Addressing Data Needs			
		social sciences, general	data	standards	

APPENDIX 5 CONTINUED

WHITE PAPER	AUTHOR	FIELD OF STUDY	KEYWORD (1)	KEYWORD (2)	INTERDISCIPLINARY
143	Ericson, Richard E. Department of Economics East Carolina University NC, U.S.	A Challenge Question: Understanding, Analysis, and Management of Catastrophic Risks			
		social sciences, general	catastrophic risks	complexity	yes
33	Everhart, Nancy School of Library and Information Studies Florida State University FL, U.S.	From Paper to Pixel: Digital Textbooks in Schools: A White Paper			
		education	technology		
32	Everhart, Nancy School of Library and Information Studies Florida State University FL, U.S.	From District to Desktop: Making the Most of Broadband in Schools: A White Paper			
		education	technology	literacy	
200	Farrell, Henry J. Department of Political Science George Washington University DC, U.S.	Using New Data Analysis Techniques to Understand Information Flows			
		communication	new tools	pilot initiatives	
178	Ferree, Myra M. Sociology Department University of Wisconsin-Madison WI, U.S.	Gender Analysis and Women's Rights: A Critical Research Need			
		sociology	gender		
316	Findeis, Jill L. Population Research Institute Pennsylvania State University PA, U.S.	Network Theory and Application: Creating a Long Term Human Research (NSF LTHR) System			
		demography	social sciences		
133	Fischer, Stanley Governor Bank of Israel IS	Questions about the Future of the International Economy			
		economics	global	machine translation	
36	Fisher, Jr., William P. LivingCapitalMetrics.com CA, U.S.	Metrology for the Social, Behavioral, And Economic Sciences			
		social sciences, general	measurement		
283	Fisk, Nathan Science and Technology Studies Rensselaer Polytechnic Institute NY, U.S.	Challenging Potentials of Technological Mediated Knowledge Production			
		computer and information science	potentials for change		
274	Foran, John Sociology Department University of California, Santa Barbara CA, U.S.	Earth in Crisis?: A Forward-Looking Agenda for Research on the Cultural Causes and Consequences of Climate Change 2010-2020 and Beyond			
		sociology	climate change		
293	Fragaszy, Dorothy M. Department of Psychology University of Georgia GA, U.S.	Improving the Capability of SBE to Support Behavioral Research with Diverse Species through Shared Review in the Office of Multidisciplinary Activities			
		social sciences, general	methods	multi-disciplinary research	yes
83	Franklin, Bobby J. Education/Teacher Education & Leadership Mississippi College MS, U.S.	Using Longitudinal Data Systems to Reexamine Timeless Problems			
		education	longitudinal analysis	"drop out problem"	
256	Frodeman, Robert University of North Texas TX, U.S.	Meeting National Needs through the Social, Behavioral, and Economic Sciences			
		social sciences, general	accountability	science policy	

WHITE PAPER	AUTHOR	FIELD OF STUDY	KEYWORD (1)	KEYWORD (2)	INTERDISCIPLINARY
20	Fudenberg, Drew Harvard University MA, U.S.	Predictive Game Theory			
		economics	game theory	human behavior	yes
38	Funder, David Department of Psychology University of California, Riverside CA, U.S.	The Grand Challenges of Personality and Individual Differences for Social, Behavioral and Economic Science			
		psychology	personality	scales	yes
106	Geller, Daniel Department of Political Science Wayne State University MI, U.S.	The Impact of Global Connectedness on Urban Areas			
		urban affairs/ studies	global		
206	George-Jackson, Casey E. Department of Educational Policy Studies University of Illinois IL, U.S.	Exploring Intergenerational Influences on First-Generation College Students			
		education	family	generational influences	
227	Gilbert, Christopher C. Anthropology Hunter College of the City University of New York NY, U.S.	Bridging Molecular and Paleontological Evidence for the Origin and Diversification of Major Primate Groups			
		anthropology	paleoanthropology	animal studies	
96	Gingerich, Daniel W. Politics University of Virginia VA, U.S.	Corruption and State Fragility: A Call for a Micro-level Research Program			
		political science and government	corruption	individual behavior	
37	Gintis, Herbert Santa Fe Institute MA, U.S.	Long-Range Research Priorities in Economics, Finance, and the Behavioral Sciences			
		economics	agent-based models	laboratories	yes
279	Girju, Roxana Linguistics, Computer Science, and Beckman Institute University of Illinois IL, U.S.	Toward a New Generation of Tools and Technologies for Social Sciences: The Intertwined Role of the Humanities/Social Sciences and Engineering			
		computer and information science	centers		yes
183	Glaeser, Edward L. Harvard University and NBER MA, U.S.	Bounded Rationality in Markets and Government			
		economics	bounded rationality	markets	
258	Goldsmith, John A. Department of Linguistics University of Chicago IL, U.S.	Defining and Redefining NSF Funding for Linguistics			
		linguistics	global	technology	yes
187	Granato, Jim Hobby Center for Public Policy and Department of Political Science University of Houston TX, U.S.	SBE 2020: The Impact of the Empirical Implications of Theoretical Models (EITM) in the Social, Behavioral & Economics Sciences			
		political science and government	theory		
300	Greene, Marjorie CNA Corporation VA, U.S.	A Self-Organizing Ontology for Surveillance of Disease Outbreaks			
		health sciences	social media		
73	Greenstein, Shane M. Kellogg School of Management Northwestern University IL, U.S.	The Economics of Digitization: An Agenda for NSF			
		economics	digitization	public policy	

APPENDIX 5 CONTINUED

WHITE PAPER	AUTHOR	FIELD OF STUDY	KEYWORD (1)	KEYWORD (2)	INTERDISCIPLINARY
186	Gregory, Arofan Open Data Foundation AZ, U.S.	The Web of Linked Data: Realizing the Potential for the Social Sciences			
		social sciences, general	data	technology	
78	Gregory, Ian N. Department of History Lancaster University UK	Using Historical GIS to Understand Space and Time in the Social, Behavioural and Economic Sciences: A White Paper for the NSF			
		geography	historical GIS		yes
27	Gruber, Jonathan Department of Economics Massachusetts Institute of Technology MA, U.S.	Grand Challenges in Economics: What is the Right Amount of Choice?			
		economics	decision making	choice	
231	Guterbock, Thomas M. Center for Survey Research & Department of Sociology University of Virginia VA, U.S.	The Emerging Crisis in Sampling of Household Populations			
		statistics	sampling	survey design	
167	Habashi, Janette Department of Human Relations University of Oklahoma OK, U.S.	The Empathetic Youth Culture: Political Socialization, Value Affiliation and Transnational Identity			
		sociology	youth	global	
311	Hackett, Edward J. School of Human Evolution and Social Change Arizona State University AZ, U.S.	A Synthesis Center for the Social, Behavioral, and Economic Sciences			
		social sciences, general	social sciences		yes
149	Haftka, Raphael University of Florida FL, U.S.	Increasing the Contribution of Older Americans to the Economy			
		demography	aging	employment	
248	Hale, John T. Department of Linguistics Cornell University NY, U.S.	Linguistic Theory as an Integral part of SBE's Vision for the Language Sciences			
		linguistics	data		yes
230	Haltiwanger, John University of Maryland MD, U.S.	Making Drill Down Analysis of the Economy a Reality			
		social sciences, general	microdata		
310	Hamm, Robert M. Department of Family and Preventive Medicine University of Oklahoma Health Sciences Center OK, U.S.	Research Needed for Efficient Development and Evaluation of Methods for Transferring Diagnostic Practices to the Clinic			
		health sciences	health sciences		
253	Hamm, Robert M. Department of Family and Preventive Medicine University of Oklahoma Health Sciences Center OK, U.S.	Research to Understand and Improve the Exercise of Diagnostic Reasoning			
		psychology	diagnosis	information	
298	Hansen, Lars Peter Department of Economics University of Chicago IL, U.S.	Modeling and Measuring Systemic Risk			
		economics	models		yes
50	Hanson, Gordon University of California, San Diego CA, U.S.	Future Directions for Immigration Research			
		demography	migration	global approach	

WHITE PAPER	AUTHOR	FIELD OF STUDY	KEYWORD (1)	KEYWORD (2)	INTERDISCIPLINARY
35	Hanushek, Eric A. Stanford University Hoover Institution CA, U.S.	Developing a Skills-based Agenda fors New Human Capital Research			
		economics	skills acquisition	measurement	
245	Harden, Carol P. Department of Geography University of Tennessee TN, U.S.	A Grand Challenge for SBE: Unlocking a New Cycle of Research for Human-Landscape Interactions			
		geography	prediction	landscape	yes
267	Harley, Diane Center for Studies in Higher Education University of California, Berkeley CA, U.S.	Understanding the Drivers and Dangers of Academic Status Seeking: Studying the Impacts of Embedded Disciplinary Cultures in a Networked Academy			
		communication	higher education	prestige/rewards systems	
171	Harris, Angel L. Sociology Department Princeton University NJ, U.S.	NSF/SBE Research for 2020 and Beyond: Enhancing Fundamental Knowledge and Benefits to Society			
		sociology	inequality	migration	
104	Hart, Oliver Department of Economics Harvard University MA, U.S.	Making the Case for Contract Theory			
		economics	theory	measurement	
314	Heckman, James J. University of Chicago IL, U.S.	A Research Agenda for Understanding the Dynamics of Skill Formation			
		economics	economics		
268	Heus, Pascal Metadata Technology North America TN, U.S.	Maximizing the Potential of Data: Modern IT Tools, Best Practices, and Metadata Standards for SBE Sciences			
		computer and information science	data management	global	
235	Hibbing, John R. Political Science University of Nebraska-Lincoln NE, U.S	Individual Differences and the Social, Behavioral and Economic Sciences			
		psychology	variability	biology	yes
299	Hirsh, Haym Center for Collective Intelligence Massachusetts Institute of Technology NJ, U.S.	Collective Intelligence			
		computer and information science	collective intelligence		
221	Hoeksema, Mary Jo Population Association of America/ Association of Population Centers DC, U.S.	Comments from the Population Association of America: Future Research in the Social, Behavioral and Economic Sciences			
		social sciences, general	human capital	family	
117	Hofferth, Sandra L. Maryland Population Research Center University of Maryland MD, U.S.	Understanding the Use, Experience, and Consequences of Time Allocation in a Rapidly Changing Social Environment			
		demography	time studies		
244	Hoffmann, Michael H.G. School of Public Policy Georgia Institute of Technology GA, U.S.	Interdisciplinary Collaboration: Cognitive Conditions and Tools			
		social sciences, general	collaboration		yes
148	Hong, Jason I. Human-Computer Interaction Institute Carnegie Mellon University PA, U.S.	Understanding Human Behavior at Large Scales through Mobile Devices			
		social sciences, general	communications	technology	

APPENDIX 5 CONTINUED

WHITE PAPER	AUTHOR	FIELD OF STUDY	KEYWORD (1)	KEYWORD (2)	INTERDISCIPLINARY
134	Hubbard, Robert Glenn Dean's Office Columbia University Business School NY, U.S.	Some Compelling Broad-Gauged Research Questions In Economics			
		economics	public policy		
202	Hunter, Lori Institute of Behavioral Science University of Colorado at Boulder CO, U.S.	Getting SBE Science Out There			
		public policy analysis	communication		
315	Imbens, Guido W. Harvard University MA, U.S.	Challenges In Econometrics			
		economics	economics		
122	Jackson, Matthew O. Department of Economics Stanford University CA, U.S.	Research Opportunities in the Study of Social and Economic Networks			
		economics	networks	game theory	
217	Janoski, Thomas E. Sociology Department University of Kentucky KY, U.S.	The Vortex of Labor			
		sociology	unemployment	global	
296	Jans, Matthew E. Statistical Research Division U.S. Census Bureau DC, U.S.	Total Survey Error, Data Quality, and Statistical Error: Recommendations to the National Science Foundation's Social, Behavioral, and Economic Sciences Directorate for 2020 Planning			
		statistics	method		
160	Jarvenpaa, Sirkka L. IROM University of Texas at Austin TX, U.S.	Vigilant Interaction: Managing the Vulnerabilities in Online Knowledge Collaborations			
		sociology	online world	trust	
247	Jindra, Michael Anthropology University of Notre Dame IN, U.S.	Understanding the Implications of Increased Lifestyle Diversity			
		anthropology	life style	household	yes
291	Johnson, Dominique E. Social Science and Human Services Ramapo College of New Jersey NJ, U.S.	Toward an Analytics of Gender			
		sociology	gender		
138	Jorgenson, Dale W. Harvard University MA, U.S.	A New Architecture for the U.S. National Accounts: A Grand Challenge for the National Science Foundation			
		economics	public policy		
150	Kapteyn, Arie Labor and Population RAND Corporation CA, U.S.	Measurement and Experimentation in the Social Sciences			
		social sciences, general	method		
261	Kasakoff, Alice Bee Department of Geography University of South Carolina SC, U.S.	Scaling Down: Social and Economic Processes Over Time at a Local Scale in the U.S.			
		geography	GIS		
228	Katerndahl, David A. Department of Family & Community Medicine University of Texas Health Science Center at San Antonio TX, U.S.	Application of Complexity Science to the Study of Social Systems			
		social sciences, general	complexity	models	

WHITE PAPER	AUTHOR	FIELD OF STUDY	KEYWORD (1)	KEYWORD (2)	INTERDISCIPLINARY
251	Katz-Buonincontro, Jen School of Education Drexel University PA, U.S.	A Framework for Researching Student Creativity in Game-Based Learning Environments			
		education	games	technology	
312	Kim, Tschangho John University of Illinois at Urbana-Champaign IL, U.S.	Urban Space with Instant and Ubiquitous Access Technologies			
		urban affairs/ studies	public policy		
241	Kintigh, Keith W. School of Human Evolution & Social Change Arizona State University AZ, U.S.	Synthesis and Cyberinfrastructure for SBE Research			
		social sciences, general	cyber-infrastructure	science communication	yes
224	Kleinman, Lawrence C. Department of Health Evidence & Policy Mount Sinai School of Medicine NY, U.S.	White Paper Encouraging an Agenda for Social, Behavioral, and Economic Sciences to Advance Measurement Serving Community Based Research			
		health sciences	translational research		
287	Kolar, Christopher G. Office of Institutional Research Illinois Mathematics and Science Academy IL, U.S.	Existing Specialty Schools as Leverage for Behavioral Sciences Research on Teaching and Learning in STEM Fields			
		education	STEM education	NSF support	
277	Koppl, Roger Fairleigh Dickinson University NJ, U.S.	Epistemic Engineering			
		engineering	complex systems	agent based models	
54	Koschmann, Matt Department of Communication University of Colorado at Boulder CO, U.S.	Effective Collaboration in a Complex and Interdependent Society			
		social sciences, general	collaboration	cyber-infrastructure	
43	Kramer, Michael W. Department of Communication University of Oklahoma OK, U.S.	White Paper: Institutional Review Boards			
		education	Institutional review boards		
304	Kroszner, Randall S. Booth School of Business University of Chicago IL, U.S.	Implications of the Financial Crisis for the Grand Challenge Questions for the NSF/SBE			
		economics	economic history	learning	
65	Kuhn, Peter Department of Economics University of California, Santa Barbara CA, U.S.	Modelling and Testing Human Interactions in the Laboratory and the Field			
		social sciences, general	behavior		
47	Laituri, Melinda J Natural Resources Ecology Laboratory Colorado State University CO, U.S.	Understanding Slow Onset Disaster in the Age of Climate Change			
		biological/ biomedical sciences	climate change	disasters	yes
51	LaMuth, John E. JLM Mediation Service CA, U.S.	The Communicational Factors Underlying the Mental Disorders			
		psychology	mental disorders		
170	Laubichler, Manfred D. School of Life Sciences Arizona State University AZ, U.S.	Transforming Science Studies through Collaborative Informatics Approaches and Infrastructure			
		public policy analysis	informatics	history/philosophy of science	

APPENDIX 5 CONTINUED

WHITE PAPER	AUTHOR	FIELD OF STUDY	KEYWORD (1)	KEYWORD (2)	INTERDISCIPLINARY
89	Leblang, David Politics University of Virginia VA, U.S.	Food (In)Security			
		international relations/affairs	food supply	global	
294	Lee, Matthew Sociology Department Louisiana State University LA, U.S.	A Potential Agenda for SBE for 2020 and Beyond			
		social sciences, general	integration of physical and biological sciences		yes
263	Leigh, Steven R. Anthropology, Institute for Genomic Biology, College of Medicine University of Illinois IL, U.S.	Linking Biological and Social Sciences in SBE			
		biological/ biomedical sciences	scientific research	theory/practice	yes
169	Levine, Daniel S. Department of Psychology University of Texas at Arlington TX, U.S.	Inclusive Decision Making			
		cognitive psychology	decision making	global climate change	yes
113	Levine, David K. Department of Economics Washington University in St. Louis MO, U.S.	Virtual Model Validation for Economics			
		economics	models		
105	Liang, Daan Construction Engineering Texas Tech University TX, U.S.	Transforming Economics, Social and Engineering Research to the Science of Disaster Resiliency and Recovery			
		engineering	sustainability	disasters	yes
259	Littell, Julia H. Graduate School of Social Work and Social Research Bryn Mawr College PA, U.S.	The Science of Research Synthesis: An Empirical Foundation for Future Research in the Social, Behavioral, and Economic Sciences			
		social sciences, general	science of research synthesis		
213	Livingood, William C. Duval County Health Department and University of Florida College of Medicine FL, U.S.	Society for Public Health Education (SOPHE) White Paper on Applied Approaches to the Social and Behavioral Health Sciences: Response to the National Science Foundation Call for Recommendations on Future Research in the Social, Behavioral & Economic Sciences			
		health sciences	scientific research	collaboration	
93	Lo, Andrew W. Sloan School of Management Massachusetts Institute of Technology MA, U.S.	SBE 2020: A Complete Theory of Human Behavior			
		social sciences, general	interdisciplinarity		yes
108	Lobao, Linda M. Rural Sociology, Sociology, and Geography Ohio State University OH, U.S.	Spatial Inequality: A Research Agenda for the Social Sciences			
		geography	inequality	ecology/ environment	yes
135	Loughran, Thomas A. Department of Criminology and Criminal Justice University of Maryland MD, U.S.	A Reassessment of the Role of Offender Risk in Criminal Decision-Making			
		criminology	decision making	criminology	yes
271	Lyons, Patrick D. Arizona State Museum University of Arizona AZ, U.S.	The Scientific Strategy of Conserving and Researching Existing Anthropological Museum Collections			
		anthropology	data/collections management		

WHITE PAPER	AUTHOR	FIELD OF STUDY	KEYWORD (1)	KEYWORD (2)	INTERDISCIPLINARY
254	Marchak, Frank M. Veridical Research and Design MT, U.S.	Credibility Assessment Research			
		social sciences, general	credibility assessment		
292	Masse, W. Bruce ENV-ES Environmental Stewardship Group Los Alamos National Laboratory NM, U.S.	Identifying the Quaternary Period Record of Cosmic Impact and Exploring its Implications for Past Human Biological and Sociocultural Evolution and Future Societal Response			
		atmospheric science and meteorology	planetary science		
159	McClelland, James L. Department of Psychology Stanford University CA, U.S.	Understanding the Mechanisms of the Mind through an Integrated Science of the Mind Initiative			
		psychology	Science of the Mind		
9	McCloskey, Deirdre N. Economics, History, English, and Communication University of Illinois at Chicago IL, U.S.	Language and Interest in the Economy: A White Paper on "Humanomics"			
		economics	communication	language	
194	McCorriston, Joy Anthropology Ohio State University OH, U.S.	Future Research in the SBE Sciences: A View from Anthropology			
		anthropology	cultural structures		yes
128	McCullough, Michael E. Department of Psychology University of Miami FL, U.S.	What Would Happen to the Human Sciences if We Took Seriously the Fact that Behavior is Caused by Mental Mechanisms that Evolved to Execute Specific Functions?			
		cognitive psychology	brain	data/archiving	yes
189	Medin, Douglas L. Department of Psychology Northwestern University IL, U.S.	Diversity in the Social, Behavioral and Economic Sciences			
		social sciences, general	diversity	NSF Pis	yes
182	Mendenhall, Ruby Sociology and African American Studies University of Illinois IL, U.S.	Rethinking 21st Century Urban Transformations: Race and the Ecology of Violence			
		sociology	urban	inequality	
190	Mendes, Pedro Technical University of Lisbon PO	Moving Forward in Organizational Science			
		industrial and organizational psychology	translational research	community health	
174	Michel, Sonya A. United States Studies Woodrow Wilson International Center for Scholars DC, U.S.	Gender, Migration and the Challenge of Global Policymaking for Social Care			
		public policy analysis	children	global	
219	Mitchener, William G. Mathematics Department College of Charleston SC, U.S.	The Evolution of Natural Computation, Behavior, and Instinct, and the Need for Mathematical Modeling and Mathematical Literacy in the Social, Behavioral, Cognitive, and Economic Sciences			
		mathematics	models		yes
168	Moffitt, Robert A. Department of Economics Johns Hopkins University MD, U.S.	A New Household Panel for the U.S.			
		social sciences, general	data	panel study	

APPENDIX 5 CONTINUED

WHITE PAPER	AUTHOR	FIELD OF STUDY	KEYWORD (1)	KEYWORD (2)	INTERDISCIPLINARY
176	Nelson, Julie A. Department of Economics University of Massachusetts Boston MA, U.S.	Economics, Climate, and Values: An Integrated Approach			
		humanities	economics		yes
165	Neuberg, Steven L. Department of Psychology Arizona State University AZ, U.S.	Complex, Global-Scale Security Challenges Require Enhanced Scientific Infrastructure			
		psychology	security	global	yes
12	Neuby, Barbara L. Political Science Kennesaw State University GA, U.S.	What Power the Administrative State?			
		Political science and government	governance	public administration	
127	Nordhaus, William Department of Economics Yale University CT, U.S.	Some Foundational and Transformative Grand Challenges for the Social and Behavioral Sciences: The Problem of Global Public Goods			
		economics	public goods	global	yes
192	O'Gorman, Ned Department of Communication University of Illinois IL, U.S.	Public Science: A Call			
		communication	public science		
238	Oliva, Aude Brain and Cognitive Sciences Massachusetts Institute of Technology MA, U.S.	Understanding the Physics of the Mind: A Proposal for a Perceptual Science Initiative			
		cognitive psychology	perception		
100	Owens, J. B. History Idaho State University ID, U.S.	Understanding the Impact of Nonlinear Dynamics on the Processes of Human Systems			
		geography	GIS	history	
97	Page, Scott E. Complex Systems University of Michigan MI, U.S.	Complexity in Social Political and Economic Systems			
		social sciences, general	complexity	adaptive systems	yes
302	Pardo, Theresa A. Center for Technology in Government State University of New York—Albany NY, U.S.	Information and Technology: Improving Public Sector Capability to Address Societal Challenges			
		political science and government	information technology		yes
144	Patterson, Craig M. Grandfather OR, U.S	Sustainable Forestry and Holistic Analysis			
		biological/ biomedical sciences	rural	sustainable development	
102	Pentland, Brian T. Eli Broad College of Business Michigan State University MI, U.S.	Networks of Action in Social Science Research			
		social sciences, general	networks of action		
243	Pescosolido, Bernice A. Sociology Department Indiana University IN, U.S.	The Role and Potential Impact of Social, Behavioral and Economic Science Approaches to Networks in the First Half of the 21st Century: Grand Challenges of Substance and Methods			
		sociology	network analysis	models	yes

WHITE PAPER	AUTHOR	FIELD OF STUDY	KEYWORD (1)	KEYWORD (2)	INTERDISCIPLINARY
209	Poole, Marshall S. Institute for Computing in Humanities, Arts, and Social Science University of Illinois IL, U.S.	Data Driven Discovery In the Social, Behavioral, and Economic Sciences			
		social sciences, general	petascale datasets	data driven inquiry	
126	Poterba, James Department of Economics MIT and NBER MA, U.S.	Research Opportunities: Financial Economics, Public Finance, Energy Markets, and an Aging Society			
		economics	energy	aging	
173	Preuss, Todd M. Yerkes National Primate Research Center Emory University GA, U.S.	Discovering Human Brain Specializations			
		cognitive psychology	brain	natural selection	
63	Pye, Clifton Department of Linguistics University of Kansas KS, U.S.	A Distributed Architecture for the Documentation of Language and Culture			
		linguistics	endangered languages	global	
210	Raymond, Ronald A. Research Management Office Ocean Education, Technology and Sciences Parternship WA, U.S.	Enabling Game Science Research for Transforming Regional Economic Development Policy in the United States of America for the Early 21st Century			
		economics	game science	innovation	
185	Reis, Ricardo Department of Economics Columbia University NY, U.S.	Three Challenges for Macroeconomics			
		economics	social transfers	information technology	
14	Restivo, Sal Science and Technology Studies Rensselaer Polytechnic Institute NY, U.S.	The Brain and Human Behavior: The Neuroscience/Social Science Nexus			
		cognitive psychology	brain	cultural context	yes
262	Ribes, David Communication, Culture & Technology (CCT) Georgetown University DC, U.S.	The Long Now: Revolutions in Knowledge Production and Exchange in the 21st Century and the Need for Large-Scale, Long-Term Qualitative Research of Sociotechnical Systems			
		computer and information science	scientific research	theory/practice	
215	Rivers, Susan E. Department of Psychology Yale University CT, U.S.	Transforming Education through Scientifically Rigorous Intervention Approaches: A Call for Innovations in the Science of Emotional Intelligence			
		education	emotional intelligence	children	
68	Roberts, Karlene H. Haas School of Business University of California, Berkeley CA, U.S.	Evolving Research for the Social, Behavioral and Economic Sciences of NSF			
		industrial and organizational psychology	crisis prevention	collaboration	yes
31	Rodrik, Dani John F. Kennedy School of Government Harvard University MA, U.S.	A Research Agenda in Economic Diagnostics			
		economics	diagnostics		

APPENDIX 5 CONTINUED

WHITE PAPER	AUTHOR	FIELD OF STUDY	KEYWORD (1)	KEYWORD (2)	INTERDISCIPLINARY
52	Rogoff, Kenneth S. Department of Economics Harvard University MA, U.S.	Three Challenges Facing Modern Macroeconomics			
		economics	markets	computer science	
166	Roschelle, Jeremy Center for Technology in Learning SRI International CA, U.S.	Insightfully Linking 21st Century Learning to the 21st Century Economy			
		education	economics	STEM pipeline	
107	Roth, Alvin E. Department of Economics Harvard University MA, U.S.	Market Design: Understanding Markets Well Enough to Fix Them When They're Broken			
		economics	market design		
55	Rubin, Philip Haskins Laboratories CT, U.S.	Real-World Speech Recognition			
		communication	speech recognition	technology	
140	Russell, Elizabeth M Department of Family and Consumer Sciences Texas State University-San Marcos TX, U.S.	Parent Involvement and Kindergarten Readiness: An Approach for Success			
		education	"unreadiness"	interventions	
208	Russell, Jennifer L. School of Education University of Pittsburgh PA, U.S.	Understanding Learning in Organized Settings			
		education	learning	multi-tasking	yes
204	Sahdra, Baljinder K. Center for Mind and Brain University of California at Davis CA, U.S.	Neuroplasticity, Meditation Training, and the New Mind			
		cognitive psychology	brain		
111	Samuelson, Larry Department of Economics Yale University CT, U.S.	Future Research in the Social, Behavioral and Economic Sciences			
		social sciences, general	incentives		yes
237	Sastry, Narayan University of Michigan MI, U.S.	Future Research in the Social, Behavioral, and Economic Sciences with the Panel Study of Income Dynamics			
		social sciences, general	cross-national	genetic information	
77	Sawyer, Keith Department of Education Washington University in St. Louis MO, U.S.	The Creativity Initiative: An Interdisciplinary Science of Creativity and Innovation			
		education	creativity	innovation	
284	Sayama, Hiroki Bioengineering & Systems Science and Industrial Engineering Binghamton University NY, U.S.	Sustainability of Social Systems by Suppleness			
		engineering	sustainability	suppleness	
48	Scarborough, Vernon L. Anthropology University of Cincinnati OH, U.S.	An Integrated Millennial and Centennial History for our Present and Future			
		anthropology	models	instability	yes
22	Scheff, Thomas J. Sociology Department University of California, Santa Barbara CA, U.S.	Social/Behavioral Science or Psuedoscience?			
		sociology	methods		

WHITE PAPER	AUTHOR	FIELD OF STUDY	KEYWORD (1)	KEYWORD (2)	INTERDISCIPLINARY
132	Schintler, Laurie School of Public Policy George Mason University VA, U.S.	Hierarchical Knowledge Relations and Dynamics in the 'Tower of Babel'			
		political science and government	infrastructure	public policy	
303	Scholl, Hans J. University of Washington WA, U.S.	A Grand Challenge: Shaping the Government of the Information Age			
		political science and government	information technology		yes
197	Schrodt, Philip A. Political Science Pennsylvania State University PA, U.S.	Philosophy of Scientific Political Inquiry for the 21st Century: Five Questions in Search of Research			
		social sciences, general	philosophy of science		
157	Schrodt, Philip A. Political Science Pennsylvania State University PA, U.S.	Predictive Models for Political Instability			
		political science and government	models		
175	Schunn, Christian D. Department of Psychology University of Pittsburgh PA, U.S.	Studying Educational Design: The Underexplored Tipping Point			
		education	educational design		yes
184	Segal, David Sociology Department University of Maryland MD, U.S.	Long-term Consequences of Modern Military Service			
		sociology	military service		
199	Sellers, Jefferey M. Department of Political Science and School of Policy, Planning and Development University of Southern California CA, U.S.	Transnational Research in the Social Sciences			
		social sciences, general	transnational approaches	comparative approaches	
179	Shih, Chilin East Asian Languages and Cultures, Linguistics University of Illinois IL, U.S.	Speech Variation, Graded Competency, and Human Communication			
		linguistics	speech variation	learning	
101	Smith, Michael E. School of Human Evolution & Social Change Arizona State University AZ, U.S.	An Expanded Social Scientific Perspective on Urbanism			
		urban affairs/ studies	built environment	scale	yes
41	Smith, Tom W. NORC University of Chicago IL, U.S.	Contextualizing Social-Science Data			
		social sciences, general	data		
286	Smolensky, Paul Cognitive Science Department Johns Hopkins University MD, U.S.	On the Role of Linguistics in the Future of SBE in NSF			
		linguistics	language	communication	
276	Southall, Humphrey R. Department of Geography University of Portsmouth UK	Understanding Global Change: How Best to Organize Information?			
		social sciences, general	methods	global scale	

APPENDIX 5 CONTINUED

WHITE PAPER	AUTHOR	FIELD OF STUDY	KEYWORD (1)	KEYWORD (2)	INTERDISCIPLINARY
24	Stavins, Robert N. John F. Kennedy School of Government Harvard University MA, U.S.	Some Research Priorities in Environmental Economics			
		economics	"commons" problems	environment	
155	Stevens, Larry C. Department of Psychology Northern Arizona University AZ, U.S.	Compassion and the Prevention of Violence			
		psychology	compassion		
203	Stockwell, Ian The Hilltop Institute MD, U.S.	The Role of Data and Analytical Methods in Public Discovery and Implementation			
		public policy analysis	citizen science		
152	Strauss, Sidney School of Education Tel Aviv University IS	Towards a Scientific Understanding of Teaching			
		teacher education	cognitive science	teaching	yes
130	Sun, Yifei Department of Geography California State University, Northridge CA, U.S.	Chinese Ways of Innovation and the Challenges of Understanding Research and Innovation in the 21st Century			
		geography	China		yes
147	Tapia, Mike Criminal Justice University of Texas at San Antonio TX, U.S.	Latino Gang Migration			
		criminology	Latino gangs	internal migration	
71	Tierney, Kathleen J. Dept. of Sociology, Institute of Behavioral Science Natural Hazards Center University of Colorado at Boulder CO, U.S.	Risk Governance in a Non-Linear World			
		sociology	risk		yes
154	Tonn, Bruce Department of Political Science University of Tennessee TN, U.S.	The Future of Governance and the Use of Advanced Information Technologies			
		political science and government	intelligent systems	decision-making	
26	Van Reenen, John Centre for Economic Performance London School of Economics UK	Understanding the Huge Variation in Performance between Plants and Firms in Narrowly Defined Industries			
		economics	plant/firm productivity		
62	Varian, Hal R. Department of Economics Google CA, U.S.	Clinical Trials in Economics			
		economics	experiments	administrative data	
79	Viamonte, Connie M. Global Sociocultural Studies Florida International University FL, U.S.	Girl Spotting: The Performance of Female Identity in the Virtual Gaming Community of World of Warcraft			
		sociology	gender	gaming	
99	Viatori, Max Anthropology Iowa State University IA, U.S.	The Future of Indigenous Sovereignty			
		political science and government	sovereignty	global	yes

WHITE PAPER	AUTHOR	FIELD OF STUDY	KEYWORD (1)	KEYWORD (2)	INTERDISCIPLINARY
121	Wagers, Matthew Department of Linguistics & Linguistics Research Center University of California, Santa Cruz CA, U.S.	Widening the Net: Challenges for Gathering Linguistic Data in the Digital Age			
		linguistics	games	learning	
289	Walsh, Elizabeth A. Community and Regional Planning Program University of Texas at Austin TX, U.S.	Home Ecology: The Science of Environmental Justice			
		health sciences	health disparaties	children	
275	Walsh, Elizabeth A. Community and Regional Planning Program University of Texas at Austin TX, U.S.	Integral Learning for Environmental Justice and Sustainability			
		social sciences, general	ecological citizenship		
120	Walshok, Mary L. Dean's Office University of California, San Diego CA, U.S.	Building Cultural and Social Indicators of Regional Innovation Capacity			
		economics	globalization		yes
306	Warner, Natasha Department of Linguistics University of Arizona AZ, U.S.	SBE Grand Challenge: Understanding the Complexity and Variability of Spoken and Signed Languages			
		linguistics	spoken and signed languages		yes
158	Wasow, Thomas Department of Linguistics Stanford University CA, U.S.	Linguistics in the Twenty-First Century			
		linguistics	language	methods	
290	Waterman, Muffie W. Department of Child and Adolescent Development San Jose State University CA, U.S.	Attention in the Digital Age			
		computer and information science	learning	social cognition	
156	Watson, Richard T. MIS Department University of Georgia GA, U.S.	Energy Informatics			
		computer and information science	information systems	energy	
236	Weir, David R. Institute for Social Research University of Michigan MI, U.S.	Grand Challenges for the Scientific Study of Aging			
		demography	aging	life course	
64	Whalen, Douglas H. Haskins Laboratories CT, U.S.	Beyond Essentialist Thinking			
		social sciences, general	variation	theory	
57	Whalen, Douglas H. Haskins Laboratories CT, U.S.	Making Science Publicly Effective			
		communication	communication	language	
177	Wilson, David S. Departments of Biology and Anthropology Binghamton University NY, U.S.	The Relevance of Evolutionary Science for Economic Theory and Policy			
		social sciences, general	theory		yes

APPENDIX 5 CONTINUED

WHITE PAPER	AUTHOR	FIELD OF STUDY	KEYWORD (1)	KEYWORD (2)	INTERDISCIPLINARY
66	Winant, Howard Sociology Department University of California, Santa Barbara CA, U.S.	Race in the 21st Century: Shifting Paradigms, Changing Conditions			
		sociology	race		
11	Wright, Robert E. Division of Social Sciences Augustana College SD, U.S.	A Rationale for Funding Large Proof of Concept Proposals			
		public policy analysis	innovation	proof of concept	
307	Yitzhaki, Shlomo Government Statistician, Israel and The Hebrew University IS	Sensitivity Analysis through Mixed Gini and OLS Regressions Paper Submitted to the NSF			
		statistics	method		
92	Yuan, May University Consortium for Geographic Information Science DC, U.S.	Spatial Dynamics and CyberGIS for NSF SBE 2020			
		geography	GIS	communications/ media	
109	Zalles, Daniel R Center for Technology in Learning SRI International CA, U.S.	Expanding 21st Century Science Learning to Encompass Civic Reasoning on Science Issues			
		education	cyberinfrastructure	public policy	
164	Zaman, L. Frederick 309 SMXG, Software Maintenance Group U. S. Air Force, OO-ALC, Hill AFB UT, U.S.	The Critical Geography of American Democracy: Tectonics of the Economic, Social, and Political			
		social sciences, general	theory		
103	Zukin, Cliff Edward J. Bloustein School of Planning and Public Policy Rutgers, the State University of New Jersey NJ, U.S.	Game Change: The Challenge of Representative Survey Sampling Facing the Behavioral Social Sciences in the Decade to Come			
		social sciences, general	survey method		
118	Zvonkovic, Anisa M. Human Development and Family Studies Texas Tech University TX, U.S.	From Barriers to Bridges: Turning Great Science into Effective Policy			
		public policy analysis	public policy	economic growth	

APPENDIX 6.

OTHER PLANNING ACTIVITIES WITHIN NSF/SBE, JUNE 2010–JUNE 2011

NSF/SBE has undertaken a number of planning activities within the divisions and programs in the last year. Several are identified below; some reports have been completed; others are in progress as of this writing.

Genes, Cognition, and Social Behavior, June 28, 2010, Arlington, Virginia. Workshop description and white papers at: http://www.isr.umich.edu/cps/workshop/Welcome.html; final report: *Genes, Cognition, and Social Behavior: Next Steps for Foundations and Researchers*; prepared by Arthur Lupia; January 2011; http://www.isr.umich.edu/cps/workshop/The_Full_Report.html and http://www.isr.umich.edu/cps/workshop/NSF_Report_Final.pdf

Future Investments in Large-Scale Survey Data Access & Dissemination, American National Election Survey (ANES) General Social Survey (GSS), and Panel Study of Income Dynamics (PSID) Principal Investigators Meeting, July 26– July 27, 2010, Arlington, Virginia; Report prepared by: Patricia White, Jan Stets, Regina Werum, Christina Farhart, Sociology Program, Directorate for Social, Behavioral and Economic Sciences, National Science Foundation at: http://www.nsf.gov/sbe/ses/soc/Infrastructure_Meeting_Report_04_21_2011_FINAL.pdf

Workshop on the Future of Observatories in the Social Sciences, December 2010, Arlington, Virginia. Report in progress.

Workshop on Future Directions of Decision, Risk, and Management Science, May 6-7, 2011, Pittsburgh, Pennsylvania; description, participants' biographies, and background papers at: http://www.andrew.cmu.edu/user/rweber/DRMS/

Future Directions in Law and Social Science, May 25-26, 2011, Chicago-Kent College of Law; website under construction; report forthcoming.

Workshop on Opportunities and Challenges in Social Neuroscience (Award No. 1105506), March 21-23, 2011, Utrecht, Netherlands. Award supported U.S. participation in an international conference at: http://www.uu.nl/faculty/socialsciences/NL/Actueel/Agenda/Pages/ConferenceSocialneuroscience.aspx, which drew 140 participants.

ACKNOWLEDGMENTS

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