

**National Science Foundation
Advisory Committee for Social, Behavioral and Economic Sciences (SBE AC)
November 8-9, 2007**

**National Science Foundation
Stafford II, Room 555
Arlington, VA**

MEETING SUMMARY

Members Present

Dr. Robert Groves, Chair, SRC Research Center, University of Michigan, Ann Arbor, MI
Dr. Cynthia Beall, Department of Anthropology, Case Western Reserve University, Cleveland, OH
Dr. Cecelia Conrad, Department of Economics, Pomona College, Claremont, CA
Professor Shari Diamond, Departments of Law and Psychology, Northwestern University, Chicago, IL
Dr. Fred Gault, Science Innovation and Electronic Information Division, Tunney's Pasture, Ottawa, Ontario
Dr. Lila R. Gleitman, Institute for Research in Cognitive Science, University of Pennsylvania, Philadelphia, PA
Dr. Michael Goodchild, Department of Geography, University of California, Santa Barbara, CA
Dr. Ira Harkavy, Center for Community Partnerships, University of Pennsylvania, Philadelphia, PA
Dr. Guillermina Jasso, Department of Sociology, New York University, New York, NY
Dr. John King (CISE AC Liaison) University of Michigan, Ann Arbor, MI
Dr. Ruth Delois Peterson, Department of Sociology, Ohio State University, Columbus, OH
Dr. David Poeppel, Departments of Linguistics and Biology, University of Maryland, College Park, MD
Dr. Paula Stephan, Department of Economics, Georgia State University, Atlanta, GA
Dr. Samuel Myers, Jr. [CEOSE Liaison] Hubert H. Humphrey Institute of Public Affairs, University of Minnesota, Minneapolis, MN

Members Absent:

Dr. David Abrams, [EX OFFICIO] Office of Behavioral and Social Sciences Research, National Institutes of Health, Bethesda, MD
Dr. Claude M. Steele, Director of the Center for Advanced Study in the Behavioral Sciences and Lucie Stern Professor of Psychology, Stanford University, Stanford, CA

SBE Senior Staff Present:

Dr. David Lightfoot, Assistant Director, SBE
Dr. Judith Sunley, Deputy Assistant Director, SBE
Mr. Tyrone Jordan, Budget Officer, SBE
Ms. Lisa L. Jones, Administrative Officer, SBE
Dr. Edward Hackett, Division Director, Social and Economic Sciences (SES)
Dr. Amber Story, Acting Division Director, Behavioral and Cognitive Sciences (BCS)
Dr. Lynda Carlson, Division Director, Science Resources Statistics (SRS)

The fall meeting of the Advisory Committee for Social, Behavioral and Economic Sciences (SBE AC) was held November 8-9, 2007, at the National Science Foundation (NSF) in Arlington, VA.

Dr. Robert Groves, Chair, SBE AC, called the meeting to order at 9:00 a.m.

Welcome, Introduction of New Staff, Review of Minutes and Directorate Updates

Dr. Lightfoot welcomed several new staff members to SBE.

Front Office

Judith Sunley – Deputy Assistant Director

Rita Teutonico – Advisor for Integrative Activities

Lenore Clesceri – Program Officer, Cross-Directorate Activities (on detail)

Christopher Kello – Expert, Science of Learning Centers

Deborah Livingston – Senior IT Specialist

Mildred Brooks – Secretary to Assistant Director

Johnnie Riser – Secretary to Deputy Assistant Director

Science and Resources Statistics

Stephen Cohen, Chief Statistician, Science and Resources Statistics

Steven Proudfoot, Survey Statistician, Science and Resources Statistics

Social and Economic Sciences

Susan Haire, Program Officer, Law and Social Sciences

Nancy Lutz – Program Officer, Economics

Melanie Roberts – AAAS Fellow

Behavioral and Cognitive Sciences

Mark Weiss – Division Director (moved from Acting Deputy Assistant Director in SBE's Front Office)

Kenneth Young – Program Officer, Geography and Regional Science

Daniel Hammel – Program Officer, Geography and Regional Science

Don Grayson – Program Officer, Archaeology

Betty Tuller – Program Officer, Perception, Action and Cognition

Ping Li – Program Officer, Perception, Action and Cognition

Amy Sussman – Program Officer, Developmental and Learning Sciences

Stacia Friedman-Hill – Program Officer, Cognitive Neuroscience

Joanna Lambert – Program Officer, Physical Anthropology

Directorate Updates – Dr. David Lightfoot

Dr. Lightfoot reported that fiscal year 2007 was a good one for SBE, with budget increases, development of interdisciplinary activities, and the first ever inter-directorate standing program, Coupled Natural and Human Systems, with participation from SBE, BIO, and GEO. Other inter-directorate collaborations include Ecology of Infectious Diseases, Sensors, and International Polar Year (March 07 – March 09), the first polar year that explicitly includes the SBE sciences. SBE invested \$2M in this effort and earned \$5M of grants. Another solicitation is in progress.

In terms of FY08, we are under a Continuing Resolution, which may last as long as a year. Unlike FY07, there are no new SBE programs starting in FY08.

The largest cross-directorate activity planned for FY08 is Cyber-Enabled Discovery and Innovation (CDI), with three tracks: Data-Extraction, Virtual Laboratories, and Complexity. CDI should be a good area for SBE scientists to pursue funding because of several areas of overlap, including work on "tipping points," emergent phenomena, and complexity. The CDI solicitation is already published.

Details of the FY09 budget cannot be discussed until February, however because FY08 is the last year for HSD, HSD funds will revert to core programs in FY09. Some of the key issues (complexity, environment) explored in HSD will continue to be funded by standing programs.

SBE continues to deal with attacks and scrutiny from members of Congress, however SBE does have a few key allies, including Rep. Brian Baird, who addressed HSD PIs at the grantees meeting in October. Baird helped to make sure the SBE sciences were included in the America Competes Act.

NSF and the European Research Council jointly funded the Social Science Research Council to study the internationalization of the SBE sciences and are exploring further possibilities for collaboration. The two organizations are quite different in that while the NSF limits funding to basic science (which may then influence policy) the ERC's scientific agenda is driven more by policy makers. Dr. Lightfoot also noted that NSF's ability to encourage interdisciplinary research is unique, likely because SBE has its own platform from which to interact with other sciences.

Another key issue is that of "transformative" research, the NSF is being asked to consider whether it is too conservative in its funding decisions. One initial notion was a new funding program, then - following on a productive conversation between the Foundation and the National Science Board - they arrived at the conclusion that NSF does fund a great deal of transformative research through its regular programs, so while a separate program was not seen as helpful, they agreed that panels and reviewers should be encouraged to pay special attention to this issue. Therefore, NSF has changed Criterion I of the merit review to include language about the importance of transformative research.

Questions to Dr. Lightfoot from the Committee:

Groves: Who has the authority to direct where HSD funds will now go?

Lightfoot: SBE has been contributing \$32M to HSD. SBE will retain this full amount and will have control over it.

Stephan: How will funds be distributed?

Lightfoot: Judiciously, with priority given to support under-funded core programs rather than to start new ones. Some issues such as complexity and environment have emerged, and will be considered further by SBE senior management.

King: This is somewhat similar to experience of CISE, where they learned from experience and targeted some of the funds toward interdirector activities such as CDI.

Lightfoot: Agrees that interdisciplinarity may be key.

Beall: What about efforts to help members of Congress and other policy makers better understand SBE sciences?

Lightfoot: The Committee on Science (NSF, NIH, along with 15 other agencies) of the National Science & Technology Council has been grappling with that specific issue and with creating a strategic plan. This proved to be difficult, because not all agencies would reveal how they were funding SBE sciences. A document was drafted to help explain how the SBE sciences have changed in the past generation with the infusion of technology and to highlight potential contributions the SBE sciences can make. However, the document has not yet been cleared for distribution, but the hope is that it will be published this year. This would help toward addressing some of these issues.

Jasso: May want to follow up on the notion that multiple communities are addressing similar questions but without good communication across communities.

Lightfoot: Difficult in some cases because intelligence communities are not able to share sensitive information.

Myers: One way to encourage students from underrepresented groups to enter into and stay in the SBE sciences and become involved in policy, is to make the case that social science skills and tools can be applied to solve problems they care about. Is there more room for debate and discussion on the role of SBE in funding policy?

Lightfoot: Our sciences provide the evidentiary base for policy making, and our scientists choose topics in basic science which will be pertinent to policy makers. NSF/SBE does fund some intervention programs as well.

Myers: Follow up on previous question -- should we emphasize that more, so that we get fewer attacks?

Lightfoot: We are constantly making these points. For example, SBE has Science of Broadening Participation and SciSIP initiatives.

Groves: Have there been any steps taken to make international collaboration easier?

Lightfoot: SBE has actually taken the lead to provide two mechanisms for this – subawards and parallel proposal submissions (to NSF and to a foreign counterpart agency). The solution is not new programs and more work for NSF staff, but to use existing programs and create memoranda of understanding and harmonize deadlines. There is a common perception that international collaboration is prohibitively expensive.

Poeppl: If NSF had a new program to fund transformative research, how could we ensure SBE receives funds? Also, how can potentially transformative research be identified in advance?

Lightfoot: NSF has opted to not have such a program, but to include transformative research as a part of the intellectual merit review criteria. The notion that we often cannot identify transformative research until many years later is shared throughout NSF. A report has been published and is in the public domain.

Goodchild: What is the funding for CDI?

Lightfoot: \$50M in each of five years, for a total of \$250M over the duration of the program.

Minutes Review

Minutes Review was declared to not have any errors.

10:15–11:15

Programmatic Updates

Science of Science and Innovation Policy - Dr. Kaye Husbands Fealing and Dr. Lynda Carlson

Kaye Husbands:

SciSIP has four priority areas: Data metrics, Models, Tools, and Frameworks for International Partnerships.

SciSIP seeks to provide an evidence-based platform for science policy. NSF is carefully looking at what the research community will be able to do. These fall into three categories: developing knowledge and theory, developing metrics and analytical models, and developing the community. We are currently trying to promote a community of practice.

SciSIP is interdisciplinary in nature and scope and aims to be international and inclusive.

There are several grand challenges, both on the input and output sides. Input challenges include developing 1) a full systems approach, 2) portfolio models, 3) behavioral and dynamic models – the responsiveness of

institutions and scientists to funding agencies, policies, etc, 4) mapping and cyber tools, and 5) accounting for intangible assets and international workforce flows.

Output challenges include understanding 1) impact on societal well-being; 2) spill-over effects between discovery and technology among universities, firms, labs; 3) transformative work; 4) creativity – computational models; social and cognitive, path-breaking work; 5) diversity – evaluative approaches to measuring it, its impact on science/tech developments; what works, what doesn't, why; scholarship, ethnicity, gender; trans-disciplinary work; 6) time – how long will it be till we see the full ramification of results? Policy makers, tenure-seekers have short time-frames. We may underestimate what is going on under such pressures.

The past solicitation resulted in a total of 19 funded proposals, totaling \$6.8M.

Input proposals focused on (1) human capital and the collaborative enterprise related to STI outcomes (What is it about international partnerships that create added value? What about collaboration between academics and non-academics?, What is the role of virtual organizations?), (2) returns to international knowledge flows (What is the role of graduate students both in the US and abroad? What about the role of international post-docs?), and (3) creativity and innovation, specifically the development of cognitive models.

Systems proposals focused on the knowledge production system (high risk versus low risk, complexity systems modeling, mapping tools of science, and international databases).

Near term goals for the SciSIP program include developing two new components: data and virtual laboratories. Mid term goals include developing new S&E indicators and domain-specific models. Finally, the key long-term goal is to understand, based on discussions with universities and industries, what directions should be pursued.

Dr. Lynda Carlson:

Dr. Carlson reported that SRS is doing work that compliments the SciSIP research efforts. SRS is currently updating the Industry R&D Survey, which had not been significantly changed since the 1950s. This survey looks at the manufacturing and service sector. Other surveys (Academic R&D, S&E Higher Education, and S&E Workforce) are also being updated. These have not been changed since the 1970s.

These are long overdue for updates since many fundamental changes have occurred in both the academy and industry.

SRS will have an entirely new data set by 2010. Broad goals include improving data collection on post-docs and undergraduate students and improving data collection on processes of innovation.

SRS is convening a series of expert panels in major topical areas, exploring the feasibility of linking SRS data sets with other data sets, the feasibility of collecting SciSIP data from non-profits, and on improving usability of data. SRS is also holding workshops with data users on issues related to SRS data.

Questions to Drs. Husbands Fealing and Carlson from the Committee:

Diamond: What sorts of intellectual property data are available with the Industry Survey?

Carlson: The survey includes data on patents, licenses, and collaborations with academic institutions.

Goodchild: What fields are listed on the field of degree question?

Carlson: Two different lists are currently being tested.

Harkavy: Science and innovation are very important issues, and serve as an example of how social science can have a fundamental role in solving something critical to society and to social values. This is a very useful model to study for understanding the role NSF can play in leading to fundamental changes in policy.

Poeppel: What constitutes success in a SciSIP project?

Husbands Fealing: Metrics include what will it net in usefulness to policy makers? Does it make a significant contribution to a literature? Is this a step toward understanding a process better? With SciSIP, there is added emphasis on broader implications, not just scientific merit.

Lightfoot: This initiative has helped energize our directorate, with a range of topics addressed that is truly impressive. SBE was initially concerned about receiving an overwhelming number of proposals, but because of careful crafting of the solicitation, this did not occur. Members of the SciSIP panel were highly distinguished, and each funding decision was unanimous.

Science of Learning Centers – Dr. Soo-Siang Lim

A holistic study of learning requires expertise from diverse disciplines, beyond the scope and scale of individual investigators. The SLC research program was established in 2003 to offer large scale, long term awards for the creation of centers to provide infrastructure and support for the study of complex investigations of learning in animals, humans, and machines. SLC encompasses learning at many levels from the cellular and molecular, to behavioral, cognitive, and social, and includes work on machine learning, artificial intelligence, and robotics.

There are currently six centers; each has a unifying research focus, employing multiple approaches to study learning. The first cohort of centers was established in 2004, with \$4 to 5M/year. These awards were initially funded for 5 years, with the option of renewal for an additional 5 years. The second cohort was funded in 2006, with \$1.5M for the first year and \$2M for the second year. Upon satisfactory performance, these will receive full funding of \$4M/year.

First Cohort:

LIFE – Center for Learning in Informal and Formal Environments, University of Washington

- Studying how people innovate throughout lifetime
- The center is exploring:
 - Social foundations of learning – what basic processes and mechanisms underlie social learning? How do they differ across domains, contexts and developmental stages?
 - Social practices in informal and formal environments – what are the barriers that impede learning in these environs, or the bridges that enhance learning?
 - Social designs – translating theory into practice, building from the first two sets of questions

CELEST – Center of Excellence for Learning in Education, Science, and Technology, Boston University

- Studying autonomous real time learning with experimental methods
- Looking at perception-cognition-emotion-action cycles involving visual, temporal, parietal, prefrontal cortices
- Developing learning algorithms to contribute to biologically-inspired smart machines

PSLC – Pittsburg Science of Learning Center for Robust Learning, Carnegie Mellon University

- Goal is to yield theoretically sound and useful principles of robust learning. Using LearnLab and international resources in class testbeds
- Developing several cyber-enabled courses ranging from chemistry, physics, algebra, and geometry to language learning including English, Chinese, and French.

Second Cohort:

VL2 - Visual Language and Visual Learning Center, Gallaudet University

- Studying visual language acquisition and literacy, inter-language and inter-modal language mapping, language structure and visual modality

TDLC – Temporal Dynamics of Learning Center, University of California, San Diego

- Exploring the role of time and timing in learning over multiple scales, brain systems, and social systems.
- Notion is that time matters for input processing, for consolidation, for remembering, for performance, and for output dynamics.
- Developing network-of-networks solution involving sensor motor functions, memory systems, perceptual expertise, and social interaction

SILC - Spatial Intelligence and Learning Center, Temple University

- Studying mechanisms to understand spatial thinking and learning

The center mode allows for cross-fertilization of ideas because it establishes a critical mass of experts. Other benefits include a more holistic understanding of learning and timely communication and synthesis of results which facilitate longitudinal study, greater risk taking and more planning for future studies. Centers generate resources and infrastructure for their larger research communities. Also there is a critical mass of students, which provides training, mentoring, and teamwork opportunities.

Beyond the focus of each individual center, there are several emerging and cross cutting themes across all centers. The study of language learning (language, speech, bilingualism) features prominently across the centers.

In addition to the center awards, the SLC program also makes catalyst awards, up to \$250k each, to support limited duration research, partnership, and infrastructure building activities.

Activities in FY07 focused around program review and management, including the start up of new centers and the annual review of existing centers. The SLC program offered supplements to other non SLC awards to fund collaborations with SLC researchers.

In FY08, SLC will review the first cohort awards and process renewals. SLC staff will also review the second cohort of awards to determine which will receive full funding. SLC also plans to conduct a COV in FY08.

Program Management includes two SBE program officers and a Coordinating Committee, with technical coordinator representatives from each research directorate.

Questions to Dr. Lim from the Committee:

Poepfel: Why was the second cohort funded differently than the first cohort?

Lim: A phased funding approach helps to ensure that the centers will be successful. It allows NSF to have more oversight and direction and better understanding where the money is being spent.

Gleitman: One of the virtues of larger funding is the freedom for centers to move ahead in quite general (and possibly unplanned) ways. The increased degree of oversight might stifle progress.

Lim: SLC uses the same reporting requirements as any other NSF centers: annual reports and site visit reviews. The SLC program understands that the success of the centers often rests on coordination and management. For that reason, the reviews include strategic planning to assess management needs. The awards are funded as cooperative agreements, where NSF is working in partnership with the Centers.

Goodchild: Is the portfolio distributed equally over the lifespan?

Lim: This is a very nascent program, and it is not possible for six centers to cover all of learning – it is too immense. The program would like to build capacity within areas where there is a gap in representation within the portfolio.

Beall: The social organization of learning involves teachers, so what is NSF's reason for not addressing this aspect as thoroughly as it could?

Lim: The centers do work in partnership with schools. SLC prepared a handout with links to each of the centers to learn more about what activities they are involved in with outside educators.

Poepfel: Since all six centers use neuroimaging methodologies, and all encompass language learning, has SLC had a meeting to convene all the center directors?

Lim: The second cohort awards were funded only recently, so we are just beginning to see the themes emerging across them all. We plan to begin assessing how to share knowledge across the centers.

Myers: This seems like an area that would benefit from bringing together these PIs with those funded through the Department of Education and NIH.

Lim: SLC does have collaboration with other agencies.

Harkavy: NSF may want to consider exploring the interplay between practitioners and non-practitioners and theory and practice in the next round of funding.

11:15 – 12:15

Broadening Participation – Dr. Celeste Rohlifing

At a recent meeting of the Director's Review Board the issue of having relatively few women and underrepresented groups in NSF's review process arose. A Broadening Participation Working Group (BPWG) was set up within the Foundation, chaired by Celeste Rohlifing, MPS/CHE and Victor Santiago, EHR/HRD to address the issue of persistent under-representation of women and minorities in science and engineering.

The group was charged with increasing representation of under-represented groups in NSF programs and activities and to increase participation of under-represented groups in the reviewer pool. The BPWG includes one representative from each directorate. Kellina Craig-Henderson is the SBE representative. The WG met weekly starting in April, with regular attendance of over 30 program staff, most of whom are program officers. The BPWG prepared a report and strategic plan entitled, "*Investing in America's Future*," which is now being reviewed by senior management.

The report is roughly 25 pages of text and 25 pages of appendix material. A total of 59 NSF programs were identified as relevant to broadening participation. The report identifies six major recommendations:

- Maintain and regularly update the NSF portfolio to facilitate coordination across the Foundation and to expand the knowledge base that informs these programs.
- Diversify the reviewer pool by providing a searchable reviewer database with complete demographic data. NSF needs to encourage reviewers to supply demographic data.
- Train NSF staff on effective community outreach and cultivating new sources of reviewers.
- Disseminate broadening participation information, including through websites.
- Hold PIs accountable by requiring them to report on outcomes of their broadening participation efforts identified in the proposal. Hold POs accountable for efforts on broadening participation during annual review.
- Develop a COV on broadening participation or evaluate programs individually.

The next step is to get feedback by senior management, then finalize document in December 2007. After the document is published, there will be a period of public comment, followed by implementation of the ideas within the strategic plan.

Reporting rates for demographic data are 95% for PIs and 25% for reviewers.

Questions to Dr. Rohlfig from the Committee:

Q: Is the focus of this report only on women and underrepresented groups?

Rohlfig: No, the group is also looking at persons with disabilities as well as issues of geographic and institutional diversity.

Q: NSF should not just look at citizenship, but also where researchers come from.

Rohlfig: This is a good suggestion and will be shared with the working group.

Q: Why are we only now recommending reviewers to report demographic data? Is it possible to require reviewers to provide this data, where one option could be “refuse to report” – so that they can opt out?

Rohlfig: Legally, we cannot require reviewers to report, but the working group is considering changing the survey format somewhat to encourage greater response rate.

Q: People will not report this data unless the reason for doing so is compelling.

Rohlfig: The working group is considering providing more details about why the data is important and providing reviewers with greater incentive to respond.

SBE Specific Topics

12:15 – 1:30

Working Lunch, Cyber-enabled Discovery and Innovation – Dr. Cheryl Eavey

CDI represents a \$52M commitment in the FY08 budget. Approximately half the budget will go to the agency-wide program, and the other half to the directorates. The funds within SBE will be spent on two elements of SciSIP – data dissemination and virtual collaborations. SBE research is likely to be funded through the agency-wide program. Dr. Terry Langendoen and I are the SBE representatives to the CDI group.

CDI is a 5 year initiative, involving all of NSF’s directorates and program offices. Emphasis is on work that is bold, radical, revolutionary, paradigm-changing, and transformative. CDI projects must be multi-disciplinary and must involve innovative use of theory, tools, algorithms, or models.

The underlying philosophy of CDI is not “business as usual.” Instead of incremental work, there is a focus on untraditional approaches and collaborations that do not fit in standard programmatic areas.

In addition to the new transformative emphasis as part of the intellectual merit criterion, CDI proposals will also be judged by how multi-disciplinary they are, how innovative they are, their likelihood to create synergies within fields and to create new fields, and their ability to disrupt existing theories and revolutionize disciplines.

CDI has three areas:

- **From Data to Knowledge:** focus on improving our ability to gather, organize, analyze, model, visualize large multiscale heterogeneous data.
- **Understanding Complexity:** focus on identifying what breakthroughs could potentially occur in the area of complexity. This area is likely to involve mathematical and statistical modeling and nonlinear couplings across multiple scales.

- **Virtual Organizations:** focuses on creating systematic knowledge of the intertwined social and technical issues of effective virtual organizations.

With respect to broadening participation, the CDI announcement is very inclusive in its call. It is targeted at a diverse array of disciplines, researchers, and students. CDI research may also involve partnerships with industry and international organizations.

There are three types of projects. These are not based on dollar amounts, but on methods or modalities.

Type I: require a duration of 3 years.

Type II: longer term; require a duration of perhaps 4 years, and a larger team.

Type III: these will not be funded in the first year, but in subsequent years and will be funded as centers.

Letters of intent must be submitted between October 30 and November 30 and preliminary proposals between December 7 and January 8. Full proposals will be submitted by invitation only.

Questions to Dr. Eavey from the Committee:

Goodchild: Why do letters of intent and preliminary proposals have a submission window rather than one deadline?

Eavey: The window of time is to help NSF keep better track of the letters of intent.

Gleitman: This is a very exciting program, but there are concerns with its emphasis on not funding “business as usual,” because some of this research is very high quality and would contribute positively to CDI.

Eavey: NSF has faced the issue of how to balance the continuity of excellent research versus funding new, exciting activities many times, so this is a question that goes beyond just CDI. While CDI is encouraging new collaborations, the new announcement does not rule out single investigators as long as the research is published in two different areas.

Lightfoot: NSF has to go to Congress each year to develop its budget. In any given year, all programs are eligible for a general increase, but building the budget around larger compelling ideas impacts core programs in a positive way and energizes the research community.

Poeppe: There seems to be a notion that big ideas are inherently interdisciplinary or multi-disciplinary, when this is not necessarily so.

Lightfoot: This is a fair observation. The strategy now because of the American Competitiveness Initiative (a commitment to doubling the NSF budget over 10 years) is to argue for new initiatives and priority areas. CDI is the first big idea that has made it through the NSF-wide budget building process.

Jasso: How does NSF define “computational” – does this necessarily require machines and computers? Does work have to be paradigm-shifting over more than one field?

Eavey: The CDI announcement does not give a precise definition. With respect to whether a project is paradigm-shifting, the panel will need to decide.

King: Is the NSF putting too much emphasis on funding interdisciplinary work, to the point that it is damaging the underlying foundation? Perhaps SciSIP research can help address whether this is the case.

Sunley: At AD meetings, certain theses (complexity, cyber capabilities, exploiting huge data sets effectively) arose again and again. Goal is to look at the interplay between science and the models they are building. CDI announcement hopes to address issues of data sharing and communication both within and across communities.

Myers: Because creating new partnerships requires a lot of work, is this funding mechanism the best one for achieving NSF’s goals? Will it be possible for Type I and II projects to evolve into Type III projects?

Eavey: It might be useful to have exploratory proposals first prior to full proposals, but model seems to work, based on experience with HSD and other cross-directorate initiatives.

Poepel: The more NSF focuses funding on interdisciplinary work, the more we have to deal with the metrics for rewards within academia, which does not yet fully embrace interdisciplinarity.

Eavey: Some PIs have found creative ways around this, but it is still an issue.

Beall: NSF seems to be sending the message to PIs that in order to get large awards, research must be interdisciplinary.

Eavey: NSF program officers are sympathetic to this and strive to be able to fund discipline-specific work at higher levels.

Gleitman: Some similar sorts of efforts have resulted in new disciplines or interdisciplinary research programs that have proven very fruitful.

King: Some problems are driven more by decision makers or policy makers (exogenous) than by research community (endogenous). In some of these instances, standing disciplines are not capable of answering the questions they ask.

Peterson: An emphasis on interdisciplinary research may negatively impact NSF's efforts toward broadening participation. Doing interdisciplinary work is often a challenge even for established scholars, and so maybe that much more difficult for junior researchers and underrepresented minorities. This should be considered more closely in developing solicitations.

Eavey: This is an excellent point, and one we have heard from junior investigators.

Groves: Emphasis on funding paradigm-shifting work seems high risk; what are the consequences if these efforts fail? Even if they are successful, we may not be able to recognize success until many years later.

King: It is not really possible to know - in a Kuhnian sense - what "the paradigm" is and likely is not within the power of NSF to change paradigms. NSF is, however, in a position to get people to think about problems and possible answers in different ways.

Harkavy: The value of innovative and paradigm-shifting research varies from one discipline to the next. SciSIP research may help us better understand this relationship.

Diamond: Because truly transformative is likely to be identified only many years later, it might be worthwhile to develop metrics that can be applied in the short term.

Beall: At last fall's AC meeting, Dr. Olsen said she was gathering best practices from around the foundation on doing interdisciplinary work. AC members would be interested in hearing the outcome and will ask about this during questions and answers session with Dr. Olsen.

Complexity & Systems Thinking – Jacqueline Meszaros

Complexity has become a focus at NSF. The clearest place to see this is in its position in the CDI solicitation, where the interacting elements section reads, in part, "deduce interactions in complex systems to better understand, design, and control them."

An informal NSF-wide working group was established, with an initial task of developing a workshop for an OECD forum to bring together scientists from around the world to address policy related questions. The NSF's proposal, with partners in the UK and EU, has been accepted. The dates of the workshop are not yet known, but the NSF planning group will start meeting on this at the end of November.

A small subgroup of SBE program officers also formed a working group to understand the priorities of the research community and where SBE can make investments. This group discovered that the community thinks of complexity as a style of thinking and that a significant amount of work has been done on patterns in human cognition, learning, movement, and language by modeling heterogeneous, interacting, adaptive populations. The research communities say that the SBE sciences are unique in: 1) the ability to provide rich descriptions and rich measures, 2) the commitment to validity of data and models, 3) the attention to bottom up approaches, and 4) the ability to deal with important, messy problems.

A Dear Colleague letter has just been issued to solicit proposals involving complexity and interacting systems. While there is no extra money set aside for complexity in FY08, the standing programs in SBE will likely get additional funding for this opportunity in coming years. The value of having an FY08 alert (in spite of no extra funds) is that each program officer will hear from his/her community about how they view this issue and where they see research potential.

Questions from the committee:

Gault: How does this initiative fit with SciSIP?

Meszaros: This is a wholly separate program; Dr. Husbands Fealing has already spoken about where complexity fits in SciSIP.

Q: Is the FY08 approach being characterized as "minimalist" because no extra money has been set aside?

Meszaros: Yes, but it is also minimalist in that there are no additional stipulations or requirements on the research community. The solicitation was designed to allow the community to tell NSF where they think important breakthroughs can be made. It is also minimalist in the sense that program officers can work within their existing programs.

Q: Is the primary goal for research communities to view the dear colleague letter as an opportunity to think of how their work might fit research on complexity?

Meszaros: Yes. It is a reminder to them that NSF is open to this kind of work.

Lightfoot: This topic complements Dr. Eavey's talk on CDI. This opportunity is unique to SBE and does not have the same sort of additional requirements as an agency-wide solicitation would have.

Meszaros: Another strength of this approach is that reviews will be of the same high quality as in existing programs and that the work will be judged against other research SBE is funding.

Gleitman: What is the value added to an investigator given that most can probably view one's own work in a way that would fit under general rubric of complexity and the lack of additional funding?

Meszaros: While there will not be any extra funding in FY08, it is still worthwhile to solicit proposals in this area to gain a more accurate sense of what the needs of the research community are.

Chair: NIH uses a similar mechanism and some members of the research community have grown weary of this.

Meszaros: If we receive high quality proposals, we will have learned the community is poised to do research in this area. If not, SBE might be able to identify where disconnects are and what can be done to make better connections.

Cyberinfrastructure - Dr. Daniel Newlon

The third international conference on e-social science was held in Ann Arbor in October, with doctoral colloquia, workshops, panels, papers, and poster sessions. The fourth will be held in Manchester and the fifth will be hosted by a European Union country. The question posed here is: what next? Do we continue providing support for US participation in this activity or do we want to move beyond workshops into more focused opportunities? Some think we should focus on high performance computing, while others favor focusing on teragrid.

One key NSF program is the Community-Based Data Interoperability Network (INTEROP), which recently closed for this year. A data group, organized out of the Office of Cyberinfrastructure, is looking into a national or international data framework with middleware, software, and documentation standards that would allow researchers to link and pull together data across different scientific communities. A proposal is now on the table to have all submissions to NSF include a data management plan and incorporate data management into the review process as well.

The main goal of INTEROP is to foster data exchange using robust data and metadata conventions, ontologies, and taxonomies. INTEROP is funded by all directorates and makes awards of up to \$250k for three to five years. For most proposals that SBE funds, one or more directorates are typically involved in co-funding. INTEROP will run in FY 2008-2010, making up to ten awards each year.

Another cyberinfrastructure competition, Preservation of Digital Data, will award up to \$20M for up to five years, with a renewal option for another five years. This program is being managed by OCI and CISE and is a challenge to the archive and library communities to come up with new structures for preserving data. SBE still needs to think about ways to engage its research community in this effort, and therefore is seeking input from the AC.

An international Blue Ribbon Task Force is addressing a critical challenge of the Information Age: Economic Sustainability and Preservation of Society's most Valuable Digital Data. The lead investigators are Fran Berman and Brian Lavoie and this work is jointly funded by CISE and the Mellon Foundation.

A report entitled, *Cyberinfrastructure Vision for the 21st Century Discovery* has recently been published. This is the product of an NSF working group that was tasked with preparing an inventory of cyberinfrastructure projects by directorate. The report identified several opportunities and redundancies in the following four areas: high performance computing; data, data analysis, and visualization; virtual organizations for distributed communities; and learning and workforce development.

Questions from the committee:

Lightfoot: This is a good time to point out that OCI has its own Advisory Committee; Dr. John King will act as liaison between both SBE's and OCI's ACs.

Gault: Could we bridge interoperability and CODATA? Are there worries about transmitting data?

Newlon: Yes, we need to do more in this area, but this is not part of NSF's current plan.

Groves: What is your take on why our hopes for high performance computing at the start of the 21st century have not materialized?

Newlon: We might speculate that two things have occurred, both of which are related to Moore's Law. These are: (1) that computational advances have outstripped the more quantitative fields in the SBE sciences and (2) that advances in software have made cyberinfrastructure a much more attractive tool for the more qualitative sciences. We now have the ability to use multimedia inputs, visualization, and qualitative data in ways that were not previously available, so we see a broader range of disciplines in SBE participating in cyber than before, but we do not see the heavy computational emphasis we previously saw.

Beall: With respect to preserving digital data, one of the slides shown raises the issue of whole societies and languages disappearing. Does the preservation of oral histories, ethnographies, audio interviews, etc. fall into this category?

Newlon: Most definitely. Some of the applications in archaeology and anthropology (museum collections, scanning specimens) aim to make data widely available, which is a very exciting frontier.

Deborah Winslow: One other issue is simply digitizing data; this is a crucial first step before the data can be preserved.

Doug Whalen: The Documenting Endangered Languages program is cyberintensive, but we are currently addressing problems in a piecemeal fashion, so a broader approach is needed.

Peterson: There is a lot of discussion about moving beyond the types of data SBE scientists have historically archived, including biomedical, spatial, geographic, and more qualitative kinds of data. Some of the data at the Interuniversity Consortium for Political and Social Research are not yet digitized.

Poeppel: On the issue of data storage and archiving, how much does NSF want to do versus letting Google (or some other company) do?

Newlon: NSF would likely be delighted if Google would do this, allowing us to spend money on research.

Stephan: One concern is that data preservation by industry might not be as useful or retrievable in the long-run.

Newlon: The blue ribbon committee urges directing preservation efforts at academic and non profit institutions.

Lightfoot: NSF role should be a minor one as the problem extends far beyond NSF and its resources. We are in the process of setting up an interagency working group to look at this issue.

King: A larger problem is one of retrospective conversion, dealing with data in analog formats. Google has an incentive to do conversion. A more interesting question that might arise is what data will not be converted and why not?

Sunley: Given the perception that cyberinfrastructure is associated with more quantitative social sciences, what might the impact be on underrepresented groups?

Newlon: SBE is very active in supporting Science of Learning Centers, several of which are focused on cyberinfrastructure. A learning and workforce task force will be set up, but has not yet been done. Outreach is a very important consideration.

Environment - Dr. Robert O'Connor

In terms of previous and current support for environmental research by SBE, most projects are funded by standing programs; however, there have been several special competitions in recent years spanning SBE and the natural sciences. Some SBE standing programs are very active in environmental research because of a shared theoretical emphasis (for example, Geography and Regional Science, Decision and Risk Management Science, and Anthropology), while others tend to see the environment as an “application domain.” A third group falls between these two extremes and provides some support for theoretically driven work in environmental settings.

In the mid 1990s through 2000, SBE was involved in the Human Dimensions of Global Change centers and teams. In 2004, the Decision Making Under Uncertainty centers, part of the Climate Change Research Initiative, were funded. A second group of special competitions, also started in the 1990s, included funding for methods and models for integrated assessment and relatively small amount of support for SBE science in the Long Term Centers for Ecological Research. These initiatives have not produced much in terms of publications or theoretical advances.

The big success in terms of integrating SBE and natural science environmental research has been the Coupled Natural and Human Systems program, where social scientists seem to have a significant role to play. It seems that the researchers in CNH projects are forming true communities. CNH began as a component of Biocomplexity and the Environment, which ran from FY 2001-05. It ran as a separate competition in FY 2007, with funding from BIO, GEO, and SBE. A memorandum of understanding signed by the ADs of these three directorates provides long-term support on the order of \$8M a year. This past year a total of 12 awards were made, including two that were renewals of previous CNH awards. One of these, led by Jack Liu at Michigan State University is exploring the effects of cross-boundary processes on human-nature dynamics in the Wolong Nature Reserve in China.

Unfortunately, two successful programs will be coming to an end this coming year. These are Human and Social Dynamics, where roughly one third of all awards have environmental relevance and the two Decision Making Under Uncertainty (DMUU) centers on climate change. The Decision Center for a Desert City at Arizona State University integrates GIS, economics, political science, and psychology. The Center for Research on Environmental Decisions at Columbia University integrates laboratory research with international empirical work on decision making.

One of the key lessons learned from these activities is that projects that are grounded firmly in theory, as opposed to those that are applied or reactive, are more likely to be successful because of their potential contribution to fundamental theory in and across the SBE sciences. We have also learned that while the SBE sciences are relatively new to big science, these sorts of centers have begun to demonstrate the valuable contributions of participating in larger-scale coordinated activities.

Future opportunities for the SBE sciences include the NEON and WATERS observatories, both of which are national level centers with cyber connection and ongoing flows of data. Also of interest are the Long Term Ecological Research centers. SBE has not been well represented in these efforts, but this may be changing. Areas where SBE can take the lead include (1) observatories on issues related to resilience (SBE's Decision, Risk and Management Sciences (DRMS) program along with the Institute for Mental Health Research (IMHR) and the US Geological Survey recently funded a workshop on this topic), (2) research on sustainable development (a SBE funded workshop will be held at Columbia University in the coming months), (3) research on climate change (with a suggestion of extending or recompeting the current DMUU centers), (4) research on the valuation of ecological services, and (5) research on warnings (DMRS, IMHR, and the National Oceanic and Atmospheric Administration recently issued a solicitation for work in this area).

A large gap will be created with the expiration of HSD. One possible solution might be to create a new program within SBE or possibly expanding the DMRS program to include this sort of research.

Questions from the committee:

Myers: What is meant by theory as opposed to application in environmental research?

O'Connor: One example is that we have a well-developed theory to explain variations in price of corn developed from 25 years of research. If we want to apply this theory to sorghum prices, this would be a valid exercise, but because it is lacking in theoretical breakthroughs, it would not be appropriate for NSF to fund, but might be of interest to an agency such as USDA.

Myers: Returning to the CDI solicitation, where is the line between theoretical and applied work? We keep talking about the fact that NSF only does basic science, but some of this sounds more like applied science.

O'Connor: Many projects in the environmental arena are likely to provide useful information to policy-makers. Usefulness to society is one of several possible broader impacts.

Harkavy: What terminologies are useful in the applied versus basic discussion? What types of phenomena get looked at in what ways? NSF should be the world leader in terms of adding to our body of basic knowledge.

Beall: Are any of the observatories international?

Lightfoot/Sunley: Yes and WATERS will be, but it has not yet been launched.

Chair: Are there any updates on the NEON workshop?

O'Connor: Dr. Ed Hackett (Division Director, Social and Economic Sciences) will speak more about this tomorrow. The amount of work to get NEON or WATERS off the ground is so great that one may be disinclined to share information with others.

Goodchild: The LTER centers are rather different; the SBE AC should discuss further.

Neuroscience - Dr. Douglas Whalen

Current funding from NSF for neuroscience comes across virtually all directorates and totaled about \$60M in FY 2006. One difficulty in getting exact totals is simply because it is often difficult to assess if a project is neuroscience or not. This amount does not include centers that may be doing neuroscience research. It is, however, clear that neuroscience is not a major NSF priority. An ongoing project is to distinguish how NSF funds in this area differing from that supported by NIH.

Toward that end, three workshops were recently held. The first of these, "Grand Challenges of Mind and Brain," looked at adaptive plasticity, conflict and change, and spatial knowledge. Outcomes of this workshop were an agreement that because human brain circuitry is important, future research has to have grounding in circuitry. Participants also agreed that future research should include non-human species and look at evolutionary change over time.

The second workshop primarily involved the Mathematical and Sciences (MPS) Directorate and was a useful complement to the first workshop. Participants looked at modeling and tool development. They found that researchers tend to be either modelers or experimenters, and stressed that better integration between the two will be increasingly important.

The third workshop, which will bring together MPS and SBE researchers, is titled "Cognitive Systems: Neural Bases of Thought and Behavior."

There are many promising topics within the area of neuroscience, some of which appear poised for new breakthroughs. These include research on: navigation, speech perception, face recognition, reading, perception and action, and number skills. The big question remains "how does the brain produce thought and behavior?" but many other more basic questions remain. It is clear that the SBE sciences are crucial for understanding the questions posed by neuroscience. NSF's Director, Dr. Bement, is particularly interested in answers to the question "how does consciousness arise?" We cannot address this directly, but we do have indirect means, for example differences in brain activation when a participant in a study recognizes or does not recognize a face.

NSF's Cognitive Neuroscience program receives the majority of proposals related to neuroscience, but other programs in SBE also evaluate neuroscientific work, such as projects on neural imaging of voting decisions and the use of fMRI data in lie detection.

It is clear NSF needs to distinguish itself from NIH. Further, we need to focus on problems appropriate for the scale of NSF funding and be clear to the community that research must be basic science, and not health-related. A final area NSF should work on is to continue to foster international collaboration.

Work in this area continues to grow and the upcoming decade (2010 to 2019) is being called the "Decade of the Mind."

Questions from the committee:

Q: Can you expand on how the research NIH funds differ from that funded by NSF?

Whalen: NIH does fund some basic science, but is primarily concerned with health-related questions. While NSF is often concerned with similar issues, it is problematic if the two agencies are funding the same type of work.

Q: How can we communicate to Congress that NIH is not sole source of funding for neuroscience research? Should NSF focus more on technology or on tool development?

Whalen: A strength of NSF is that it minimizes barriers for collaboration across disciplines, so it is worthwhile to emphasize this. NSF, especially SBE, can also repeat the mantra that imaging results are only as good as behavioral results.

Q: With respect to the question posed in this talk as to whether \$60M is a large or small figure for neuroscience funding, it is far too small. This is one of the biggest problems in modern science. Neuroscience at NSF is quite distinct from NIH, with its focus on neuro-tech and cognitive neuroscience (which is hardly represented at all at NIH). The five focus areas identified from the workshop could offer major, real solutions.

Whalen: Agrees that the list of "parts" of the brain will be immensely useful and that it is desirable to clarify to Congress the differences between NIH and NSF with respect to neuroscience funding.

Lightfoot: There was recently a letter in Science on the "Decade of the Mind." One might say that current proposals are re-doing the "Decade of the Brain." The "Mind" is what the "Brain" does. A linguistic cognome would help identify what the nature of matter is. There is matter between our ears that is a function of that physiology. There is a good case for major investment because it's both a fundamental question for science and for human civilization.

Comment: Even if NIH and NSF are addressing the same questions, there is still a case to be made to Congress for both agencies to offer funding. One might look to Oppenheimer's work to realize that having different teams tackle the same questions is not necessarily bad.

Comment: If it is true that the two agencies are approaching similar questions in different ways, our case is stronger. There is a precedent in government for this.

Comment: We can have a teleological discussion about what each agency is "for," where NIH is for "fixing things" and NSF is for "learning for learning's sake."

Learning - Dr. Soo-Siang Lim

The complexities of learning demand a multi-level and multi-disciplinary integrative approach, so learning as a topic is highly relevant to disciplinary collaboration and collaboration across NSF directorates.

A maxim from Benjamin Franklin states: "Tell me and I forget. Teach me and I remember. Involve me and I learn." We need a holistic view of this process, which makes centers especially valuable. Some of the Science of Learning centers focus on language learning. The CELEST center, for example, that is studying real time autonomous learning has developed neuron models of speech perception and created effective and fluid collaborations between researchers. Speech learning models are very useful and are currently in use at schools and in the home. A synthesis of results even at the center level can relate a great deal. Other SLCs investigating language learning include:

LIFE - social factors of language learning for multiple languages

PSLC- cognitive models to study learning; strategies for robust learning of language

VL2 - learning written English

TDLC - different temporal reinforcement, modeling to relate this to synapse level

SILC - role of spatial learning and transfer

Collaborations between centers are already starting to happen. It is possible that one could provide a virtual network for groups of scientists interested in this area. Centers are coordinated approaches that produce integrated knowledge and new directions for research. They facilitate the exchange and cross-pollination of ideas.

Economies world-wide are increasingly based on knowledge, so there is a fundamental emphasis on learning including life-span and life long learning. Researchers are increasingly looking at different developmental stages from infancy and early childhood to adolescents, to older adults, where individuals may have increased knowledge, but decreased executive facilities.

With respect to individual differences, we can see that the brain is truly plastic. There are possibilities for intervention that can accommodate differences, but the question as to how we develop these interventions remains.

Work on the quality of education such as "The Mozart Effect" is fraught with controversy because of misconceptions about what will and will not actually improve learning. There is a burgeoning interest in connecting neuroscience with education, but for these studies to be successful, we need support from both sides and support structures in between. We must find linkages between neuroscience, cognitive science, and

education research. There is a growing community of educational neuroscientists and the first conference of the Society for Mind, Brain, and Education will be held this month (November 2007).

We also need better teacher preparation efforts with better exposure to research methods and the research community. One problem is that there are currently no databases which collect information from teachers. We should try to encourage collaborations between educators and researchers.

Because our centers are spread out geographically, NSF should encourage mechanisms to make the data interoperable which would permit more collaboration. Engagement with the international community would likely be fruitful, too, given the relatively greater effort on these issues outside the US.

Some of the most pressing questions are: How can we coordinate all these efforts? Can we take leadership on how evaluative mechanisms should be laid out? What forms of quality control and standards exist?

Further, with rapid advances in technology we need to think about how technology can be used to enhance learning and how, in particular, it might be used to help students with disabilities. One example is with the TDLC SLC where robots are being used in the classroom to engage students in learning.

Questions from the committee:

Q: With respect to bridging the teaching and research community, what courses do teachers in these programs actually take? Can you offer details?

Lim: We do not have specific details, but the programs can provide training for teachers so that they have both a neuroscience and a teaching background. This will allow them to be resources for bridging these fields.

Q: Issues of broadening participation are particularly relevant at centers. Do you have any comments on this?

Lim: All centers are required to show improvements in broadening participation and the SLC site visitors report on this. There is a diversity of participation throughout entire structure of centers, including at the leadership level. They must demonstrate how the added resources of a center help achieve diversity.

Comment: The idea of a bridge between the education and research communities is a good one and worth further study.

Q: In light of the fact that most of the resources are already going to the centers, is there actually a possibility for funding outside of centers?

Lim: Yes, centers cannot solve all the questions, and a number of programs in SBE deal with learning. There is already significant funding outside of the centers.

Lightfoot: If there is going to be significant funding beyond what we have already, then the challenge and opportunity is to relate work going on to educational theory and practice. There is a tremendous chasm between the research and practice of learning – NSF is in a key position to bridge the gap.

Harkavy: The question of a "bridge" is a great one, because it does not involve just the poles. These are major questions, and ones which could potentially galvanize SBE. The question "Does providing citizens with an education from kindergarten through university really improve a society?" is an important one. Research and training occur infinitely better in real-world settings. If we could take this idea and develop a project that would focus on real schools, real classrooms, on the issue of translation, we would achieve better teaching, better research, and better training. Practitioners would play an active part in research.

Lim: Two of our centers have "research schools," where they are beginning to build bridges.

Diamond (comment): Looking at the centers, it seems the most important form of learning represented is in the educational system. What about the need to engage in short term learning? Does that have a place in this discussion? If so, this may resonate with members of Congress.

Q: What about NSF's Research on Learning and Education (ROLE) program?

Lim: This still exists, but has been renamed Research and Evaluation on Education in Science and Engineering (REESE) and has been expanded.

Q: What are the resources in NSF for looking at programs at both ends of the spectrum, from underprivileged school systems to universities?

Lim: This program is not designed to replace individual PI awards, but instead to take learning research to a new level. PIs can apply for supplements through the centers; this will help make the centers into national resources.

Q: Is SBE the neglected directorate? Why are we not talking about EHR?

Lim: EHR has significant investment in some of these centers.

Sunley: EHR has been involved in a lot of discussion over the past years about which agencies are responsible for education funding. It is not clear yet that EHR can provide the resources to adequately fund the sort of research these centers are doing. We should, however, try to involve them, particularly at the K-12 level.

King: It is not in the interest of SBE to move closer to EHR since EHR has come under the scrutiny of certain members of Congress. For good reasons, EHR has a separate account and is not funded out of the research activity budget.

Sunley: Congress pays much closer attention to EHR funding than to R&RA activities. It is difficult to partner with EHR because we run the risk of intervention by Congress or the Office of Management and Budget.

Q: Integrating computer science and robots in education research has been done for fifty years, with work on eye movement and motivation. Is it likely that neuroscience will change their culture and move closer to the cognitive sciences?

Lightfoot: It is too reductionist to say that neurobiologists could verify cognitive research.

Q: The Science of Learning program will be quickly discovered to be an undervalued component of NSF, but an easy target. It has the potential to be a continued point of conflict, because education dollars are already going to the Department of Education.

Lightfoot: Both the House and Senate have voted on the FY 2008 budget. The House indicates the appropriation should be \$100M over the president's budget and the Senate suggests \$110M over. The sections that Congress increased are all related to EHR funding, but presidential veto is likely due to inflation.

Q: Does this initiative belong in the social sciences?

Lightfoot: The pressures that exist now will not last forever; this too shall pass. The purpose of a scientific community is to be out in front, not without strategy, but out in front carving out areas of potentially very important new research areas. The notion that the school system is central to our society is widely recognized. It is imprudent of SBE not to get on board with this. We must proceed with caution, but this is an unusual opportunity to think about the science of this work.

5:00 – 5:30 Prepare for Meeting with NSF Deputy Director

AC will ask about the following:

Science of Learning activities

Is there a tension between letting centers manage themselves versus too much oversight on part of NSF? Are there too many reporting requirements?

Interdisciplinary Programs

What is the Foundation learning?

Is there a role for NSF on the issue of the mismatch between interdisciplinary work and tenure committees?

Should interdisciplinary research be mandated?

SciSIP

Want to convey enthusiasm for the program and for developing a better understanding of innovation science and NSF's role in this.

With respect to the maxim "study thyself," what lessons can we learn?

Neurosciences and Education

The US is falling behind international colleagues; are we trying to stay competitive? How does this relate to America Competes acts?

What are NSF's thoughts on systematically getting information from PIs about foreign training?

Are our current measurements correct?

Cyberinfrastructure

What does NSF view as its successes to date?

Other

Is there any agreement on the notion of requiring PIs to self-identify race and gender?

Friday, November 9

Working Group on Impact of Proposal Award & Management Mechanisms (IPAMM) Briefing - Dr. Jacqueline Meszaros

The IPAMM report to the National Science Board (NSB) is complete and can be found by searching for IPAMM on the NSF website. In preparing this report, the IPAMM group surveyed everyone who submitted a proposal as a PI over the past 3 years. The survey was managed by Booz Allen Hamilton and had a 56 percent response rate.

The group started as a task group to address the NSB's question as to why success rates have been falling in recent years. The IPAMM group established that the decline in success rates started around 2000. Over the period 2002-05, NSF's budget increased by 44 percent, but because award sizes increased by 41 percent, the number of awards made did not increase. Also, the number of proposals submitted increased by 50 percent during this period. This proposal pressure seems to be the main driver for declining success rates.

There is a lot of variation with respect to the timing and steepness of success rate curves across directorates, but the general pattern holds. A more detailed look at the increase in proposals shows this may be caused by a combination of factors: (1) an increase in the size of the scientific community, in particular faculty and post-docs whose salaries come from grants; (2) an increase in the number of special solicitations (these made up less than 5% of the total number in 2000, but made up 10% of the total in 2003-04); and (3) a greater need to build and maintain research infrastructures.

In terms of the impacts of this trend on the quality of research, the quality has remained high, so the issue is not that PIs are submitting lower quality work, but that NSF is turning down more meritorious research. A

danger of this trend is that PIs might become more conservative and submit only those proposals they think are likely to get funded. Applicants do believe that NSF welcomes transformative research (56%), and they perceive NSF as more willing to take risks than most other agencies, but reviewers do not report seeing many high risk projects. We can look at whether this trend is harming some groups, namely minorities and young investigators, more than others, but the data suggest that declines in success rates are being felt more or less equally across demographic groups.

This trend is having a significant negative impact on the merit review system. The review pool has only increased by 15% while proposal load has increased by 50%. Part of this is due to a trend toward only panel review, where each person reviews several proposals, as opposed to ad hoc reviews. Survey respondents said the workload for NSF and other agencies is increasing and also that the quality of their reviews is suffering. There was a survey of applicants in 2002; the 2006 survey repeated some of the questions. In 2006, even though the time to response is faster, applicants are less satisfied about the length of time between submission and response. Nearly 49% of respondents estimate NSF's success rates at 10% or lower, which is much lower than the actual rate of just over 20%.

The IPAMM group proposed a few mechanisms for improving success rates. These fell into two categories: (1) limiting the number of submissions through preliminary proposals or limiting the number of proposals by institution or by individual (institutional mechanisms are currently used by NSF for mostly non-research competitions – such as infrastructure competitions and IGERT – and individual limits are used more often by research competitions) and (2) increasing the number of awards by putting two years of funding toward a single competition or making adjustments to the balance of standard and continuing grants.

IPAMM made two main recommendations to SMART: (1) focus on developing strategies that are appropriate within the context of each unit, that balance long-term planning with the ability to respond to changing needs, and that break the decline-revise-resubmit cycle for highly fundable proposals and (2) improve communications with internal and external communities when implementing new management practices and when communicating NSF data to ensure accuracy.

Questions from the committee:

Beall: Have reviewers and PIs been asked for suggestions?

Meszaros: Yes, however there were some delays in getting the data set and the qualitative analysis has been done yet.

Gleitman: The peer reviewer situation is worrisome. Do reviewers get feedback on how their reviews are used or the fate of the proposal?

Meszaros: We share those concerns because we recognize our core competence is peer review. The IPAMM group looked specifically at workloads, but there is another group looking at this issue.

Goodchild: Does it seem that PIs are paying attention to success rates?

Meszaros: Research from behavioral economics suggests that people do not pay much attention to probabilities when making decisions, and this was found to be true here.

Diamond: There seems to be an implicit norm that if one gets funding from NSF, the obligation to review is higher. Does that happen in practice?

Meszaros: This is a worthwhile idea to pursue, but this survey did not look into this.

Groves: Were any of the recommendations aimed at minimizing the variation from one directorate to the next?

Meszaros: Not specifically; variation may be a healthy part of a complex system.

Gleitman: The issue of how much feedback the reviewers can get does come up again and again. Some programs are much more successful at getting outside reviewers to participate. What are some mechanisms for incentivizing people to serve on panels?

Meszaros: Currently each person (including ad hoc reviewers) receives a letter from the Division Director. One idea might be to also send letters of recognition to deans.

Goodchild: Is there any research on the number of reviews per proposal?

Meszaros: We have not looked at that. In SBE no ad hoc reviewer is asked to do more than two proposals in a single round.

Jasso: There is a difference in the perception of transformative research between reviewers and PIs. Are PIs unconsciously disguising transformative elements?

Meszaros: We do not know, but this is an interesting new perspective.

Beall (comment): She recently received two reviewer request letters from different POs, neither of which had a deadline or target response date.

Groves (comment): The value of this survey would be increased if NSF returns to same respondents at a later date for follow up data.

Farewells to departing AC members

9:00 – 10:00 Discussion with the Deputy Director, NSF

Welcomed by Groves. Shared with Dr. Olsen several positive comments from the SBE AC about NSF staff and programs, including SciSIP.

Groves: Concerning the Science of Learning Centers, the SBEAC would like more information as to why the new cohort of centers is being funded differently and with additional oversight. Why, specifically, are they being awarded as cooperative agreements?

Olsen: Will return to this question after an update on the budget. The FY08 budget has passed the House and the Senate. Both authorized more than the president's request, so we now need to show that we can spend the taxpayers' money wisely. We have been under a Continuing Resolution since October 1. NSF is eager for a House and Senate conference so that we can recover the \$10M taken away from AOAM; however, it is still likely that the president will veto. If the NSF bill is passed, we will be in a much better position; if we remain under a Continuing Resolution, we will return to FY06 levels for salaries and expenses.

Turning to SciSIP, she recently had a 1.5 hour briefing and finds this program to be very exciting. She attended an EPSCoR meeting the day before at which Paul Riser, the acting head of the Smithsonian Institution, gave a presentation on ways to encourage state legislators to support universities' research efforts and his talk included a slide on SciSIP. Frank Scioli then gave a longer presentation about SciSIP. It was clear that few in the audience knew this was an NSF initiative. She hopes that SciSIP will allow researchers to collect statistics that are more relevant to today's way of doing science.

With respect to SLC, the centers are supposed to be a case of the whole being greater than its parts; they are supposed to change the entire way we do science. These are modeled on the Science and Technology Centers, which were started under Eric Bloch, which had a maximum of 10 years of funding with no option for renewal. The reason NSF has opted to fund the new SLCs as cooperative agreements is because this proved to be a very successful mechanism for one of the STCs Dr. Olsen managed. This center looked at issues of circadian rhythms, and NSF oversight helped the four universities work well together; this research really

revolutionized the field. The additional oversight is needed because of the large scale and complexity of the work done by centers and also because of the high risk nature of the research in many cases.

Groves: The SBEAC is interested in hearing about the difference in funding mechanisms and oversight between the first and second cohort of SLC awards.

Olsen: This will be discussed in a closed session because the reason for increased oversight is due to an issue at one of the centers. NSF is holding the funds until the issue is resolved.

Goodchild: What are some of the pros and cons of collaborating with EHR with respect to SLCs?

Olsen: We should already have integration with EHR since SLC is a Foundation-wide initiative. The money is in the Office of Integrative Activities. SLCs have special criteria in addition to Intellectual Merit and Broader Impacts. These involve the integration of education and knowledge transfer. The AD for EHR, Dr. Cora Merritt, is working toward ensuring that EHR is research-oriented and better integrated with the Foundation's research directorates.

Goodchild: There is support for large-scale interdisciplinary science around the table and the SBEAC agrees that the possibility of SBE scientists doing big science is desirable. However, what about those researchers who are doing very good discipline-centered work? Is it possible to go too far in the direction of funding interdisciplinary work at the cost of disciplinary work?

Olsen: In terms of most new activities, SBE is a strong player and SBE involvement is a key to the success of the activity. An increasing percentage of PI initiated research involves two or more investigators; in the Engineering Directorate, nearly half of all PI-initiated projects involve two or more PIs. There have been concerns raised about the impacts of fewer single-PI projects on one's tenure prospects, but as Dr. Buckias (Assistant Director, ENG) has emphasized, tenure decisions are beyond the scope of NSF. This is simply the direction science is heading; some projects demand multiple investigators.

With respect to NSF's role, NSF has recently issued the IPAMM report and is creating a task group to look at how we do transformational and interdisciplinary research. Specific questions this group will be tasked with answering are: How are we supporting this type of research? What are the best mechanisms? Is NSF doing this well or are there areas where we can improve? Is it harder to get funding when projects need to be reviewed by two or more panels? She welcomes the SBEAC's advice on this issue.

Gleitman: She served as the director for one of the original STCs, so is supportive of interdisciplinary work, but also is worried about the balance between interdisciplinary and disciplinary research going too far in one direction. Also, because multiple investigator research is the wave of future, it can be very difficult for a single investigator to go beyond a small pilot study. However, we must be mindful that multiple investigator research is not the same as interdisciplinary research. The SBEAC is concerned that being interdisciplinary is becoming a goal unto itself.

Olsen: Single discipline, single investigator research will remain an NSF priority. However work at the margins should also have a home at NSF, provided it is reviewed with the same rigor as core research. As a neuroscientist, she is sensitive to the need to fund work that crosses disciplinary boundaries.

Harkavy: This response resonates with the discussion the AC had yesterday about how some of most complex, interesting research will require interdisciplinary efforts. He commends the study NSF plans to carry out and suggests the possibility of a serious institutional case study on, for example, the SciSIP program, looking into which questions lead to disciplinary versus interdisciplinary work.

Olsen: This will be considered. The task group will include two SBE program officers, so SBE will be well represented.

Groves: Concerned that NSF is going too far in promising (to Congress) paradigm-shifting research.

Olsen: This point is well taken and NSF strives to be clear with the language it uses.

Groves: Turning to other issues, when it is reported, for example, that the US is falling behind (or moving ahead) of another country, where do these data come from?

Olsen: We use the SRS *Indicators* reports, which include data on the number of doctorates granted by country and the number of publications generated by discipline, for example. While we have quantitative data, we have less of a grasp on qualitative aspects. It is clear that we still need a scientifically educated society for the jobs of the future, but we need to better understand **which** fields will require a larger workforce.

Jasso (comment): There may be a disconnect on the horizon between the number of foreign students we train and can keep in US based on available visas. This maybe a topic for future discussion.

Olsen: Turning to international issues, she was recently in Turkey for an OECD meeting on issues of complexity in science and observed that Turkey and some Eastern European countries are beginning to use the merit review process more.

Goodchild: Are we seeing the same trend in China?

Olsen: China has the National Natural Science Foundation, but the trend toward merit review is not as strong as it could be.

Harkavy: There might be potential in thinking about cooperation between Europe and the US on some of the major research questions in higher education.

Olsen: This sounds like a good OECD project as well. One of her concerns from the *Indicators* volume published two years ago is that while the amount of federal support is going up dramatically, the number of PIs is going down, which means we are giving more money to a select group of PIs. One of the ways that we are able to capitalize on creative people from other countries is to get people into careers very early. The average age of a researcher's first grant is 42. We are trying to get beginning scientists into faculty positions earlier

Gleitman (comment): It used to be possible to go directly from graduate school to a faculty position. Now virtually all scientists have long term post doctoral positions.

Groves: Concerning the presentation on broadening participation, it was frustrating that the group was hampered by data issues. One thought might be to add more demographic variables, including country of birth, to the survey.

Olsen: Agrees this would be a good idea to pursue.

Groves: SBE is increasingly partnering with other directorates. The SBEAC is interested in her thoughts as to what is working well and what is not.

Olsen: We want to make sure the SBE component is not just tagged on; we hope to see the SBE sciences take the lead, and add other disciplines when they seem to be needed. When you look at a lot of larger competitions, we do not have a large number of proposals coming in. Even for the Medal of Science, there are usually only about six proposals, so it can be hard to get an SBE person on the team. SBE sciences still face the stigma that their science is "soft" or that we know everything there is to know already. NSF will have another STC competition in the next few years; the SBE sciences should be preparing for this.

Lightfoot: SBE is central and fundamental to several of NSF's new initiatives, CDI being one important example.

Beall: Given the lack of involvement of the SBE sciences in some of these initiatives, are there some best practices to share with the community?

Olsen: If you know of individuals who are interested in these sorts of activities, you should advise them to speak with program officers and other staff at NSF. The success of a project comes down to strong leadership and a good strategic plan; the sum must be greater than its parts.

Lightfoot: Solicitations now include language about the centrality of the SBE sciences.

Lightfoot: Announcement that Dr. Groves will be rotating off the SBEAC and that Dr. Goodchild will serve as the next SBEAC chairperson.

10:00 – 11:45 SBE Infrastructure

Presentation by Dr. Ed Hackett and Dr. David Lightfoot

Why build major research equipment? These instruments, such as the Hubble Space Telescope, allow us to see things that we cannot even imagine are there. The Atacama Large Millimeter Array (ALMA) radio telescope is another example. The ALMA telescope will operate at wavelengths of 0.3 to 9.6 millimeters and can achieve resolutions a factor of ten higher than the Hubble Space Telescope.

LIGO, the Laser Interferometer Gravitational-Wave Observatory, is intended to detect gravity waves; can detect movement of $1/1000^{\text{th}}$ of diameter of a proton at 4 kilometers. The work that has been made possible because of LIGO is expected to create an entirely new field of science called gravitational astronomy.

The National Ecological Observatory Network (NEON) will deploy instrumentation in 20 places throughout the US. NEON will permit “studies of the biosphere at the regional to continental scales, quantifying the forces regulating these systems, and predicting the consequences of climate and land use change on the biosphere.” NEON gives SBE leverage for developing a similar pattern of centers, but with a focus on people.

These national centers and observatories allow scientists to come together and analyze data at a scale not achievable elsewhere.

In addition to ALMA, LIGO, and NEON, other current large-scale NSF projects include the Alaska Region Research Vessel, EarthScope, IceCube, the OCEAN observatory, Scientific Ocean Drilling Vessel, Advanced LIGO, and South Pole Station Modernization.

These projects take on the order of tens of millions to plan and hundreds of millions to construct; the NSF budget for ongoing construction activities is on the order of \$250M. SBE needs to think on this scale.

These projects come from the scientific community and are vetted by a committee of NSF Assistant Directors. There are several projects being developed that are not yet in the budget. The seed for NEON was first planted in September 1998, so it took a full decade of work before NEON was added to the Major Research Equipment budget line. The WATERS team established a project office in July 2005, with hopes of an award starting in 2010, with a rolling launch. In order for these efforts to not impact NSF's regular research budget, Congress created a separate budget line. NSF's approach is to spend roughly 28% of the total budget on large facilities, with most money going to operations. The review process for major facilities must still focus on the scientific goals and intellectual merit, but also examine whether enough effort has been put into getting the facility successfully launched and enough care into management so that operational costs can be managed.

In Europe, the situation in terms of developing infrastructure for the social sciences and humanities is better than in both the US and Japan. The *European Roadmap for Research Infrastructures* from the Council of Ministers which came out in 2004 was the result of two years of intensive work. It maps out future pathways for seven fields of research and was evaluated by the Roadmap Working Group.

Why do the SBE sciences need to do big science?

- Compelling science questions
- Imaginative, bold ideas
- Ideas with transformative potential
- New measures and metrics

- New modes of working, such as the National Center for Ecological Analysis and Synthesis, which includes a modeling center, distributed experiments, and work on visualization
- Security assurances and codes of ethics so that private sector data can be used safely

Starting points for the SBE sciences:

- Collect data across scales – genes to structure
- Data-theory-tools tripod; reverse salients
- Resolve sharply for power, discovery, disaggregation
- Ally with NEON and WATERS
- Seek proprietary data from sources such as Google, Yahoo, and PRIZM
- Enhance technology – Time-sharing Experiments for the Social Studies, sensors, visualization
-

What next?

The research community has to bring ideas to the Foundation; NSF then acts as a transducer (taking one form of energy into another – ideas into budgets, budgets into research capabilities)

- Organize, deliberate, mull, and simmer
- Partner with agencies, states, private sector
- Learn from European efforts
- Develop plans – don't just meet to meet
- Have patience and fortitude

Continuing the SBE Infrastructure discussion, Dr. Lightfoot introduced the topic of a Data Dream Machine for the SBE Sciences. He began by reiterating current Major Research Equipment and Facilities Construction (MREFC) projects as funded by NSF. He stated there are lots of SBE data that can be utilized by scientists which can lead to an effective SBE research infrastructure. Of NSF's MREFC projects, the National Ecological Observatory Network (NEON) was the chosen project for modeling by the SBE sciences because it parallels well with its infrastructure goals. There was a robust discussion about internal/external requirements before research infrastructure projects are approved by NSF. Dr. Lightfoot stated that the National Science Board (NSB) is very involved in MREFC and that the NSB approves NSF's annual MREFC plans. Potential fiscal and budgetary challenges pertaining to infrastructure were discussed. Subsequently, there was a discussion about pre-construction planning, development, and operating expenses associated with MREFC candidates.

Goodchild: One observation is that many prior such efforts came out of communities below the level of an NSF directorate, whereas SBE is a directorate.

Sunley: The NSF process does require Advisory Community involvement at various stages; part of this is to look at the broader community as well as the one that is making the request. The MPSAC looked very carefully at one proposal for a telescope to make sure it met the needs of the broader community of astronomy. The SBEAC might similarly be asked to evaluate whether a proposal is important to the community in terms of moving science forward.

Goodchild: SBE ran an infrastructure competition in 1999 that resulted in a set of 12 awards. Is there anything we can learn from these awards?

Hackett: We can look at a more recent experience, the Cornell Archive Project and CIDRIC (both of which have budgets of \$2M), which are ongoing and based on the same sorts of ideas.

Eavey: There were lots of ideas we were not able to support in the competitions run in 1999.

Groves: The budgets for these MRE projects explicitly note which funds are for construction, but are less specific with respect to operations. In the social sciences, operations costs are traditionally more variable than fixed costs, so our ratios would look very different from those presented in the chart showing planning and running costs. Is this a problem for us?

Hackett: The process is more organic than we might have thought a year ago. As the research community generates ideas, Dr. Lightfoot discusses these with the Foundation. The challenge is explaining data as construction cost. There are huge problems with interoperability – where data articulate with other data. Think of census, where vast amounts of data are available, but because they are so secure, they are not very useful to many researchers. NSF’s three big surveys cost approximately \$6M a year, so any one of these is roughly 10% of the total SES budget.

Jasso: Is it appropriate to discuss some ideas for large-scale initiatives at this point? All social sciences have a deep and abiding interest in understanding social hierarchies and issues of race and ethnicity. We have traditionally relied on self-reported data, but suppose we thought seriously about taking voluntary DNA swabs to be used to get at issues of geographic origins. The social sciences also have a long-standing interest in skin color, but have lacked measures for understanding this. What about the possibility of developing light meters to be used for this purpose?

Hackett: These are good ideas. The GSS and PSIS surveys will use geocoding, but we can think about including biomarkers as well.

Groves: One observation is that we are often talking about devices. Where are we blocked? The ability to take multiple measurements of alternative contexts is appearing in every discipline now. Measurement and the theory that guides it are coming up against barriers. A second consideration is to look the interaction among actors, and a third is to consider adaptive measurement – basing our measures at time T on one thing, but on another thing at time T-1. We also need to consider the mixing of modes – qualitative and quantitative data – to solve problems. There are large sources of administrative data and self-reported data that have not been analyzed because of the cost involved.

Gleitman: Another idea for SBE to consider is tracking the speech of individuals at different stages of life at the level of speech production and perception.

Goodchild: SBE sciences tend to rent buildings for infrastructure activities. Should SBE seek to build its own infrastructure?

In summary, the discussion ended with questions about the need for a brick and mortar building; ethical, legal, and social issues; and community buy-in. The SBE AC recommended funding of a workshop to pursue these and other topics. Dr. Sunley asked the AC to identify domains for a possible workshop. The following topics were suggested:

- What is the “Role of the Social Sciences?”
- Galvanize community involvement by inviting various disciplines of science and encouraging data submissions from other sciences, and
- Bring together “neural science” and the integration of “social science,” stating that this could be a very exciting area.

11:45 Working Lunch: Identification of Agenda Items for Next Meeting, Review of WebEX, Dates for Spring/Fall 2008 Meetings and Concluding Remarks

There was a discussion about the effectiveness of the WEBEX software application that was utilized during the June 7, 2007, Virtual SBE AC meeting. Overall, the SBE AC found that this software was not very effective and decided not to utilize it in the future. The standard telephone conference call method will suffice for all future needs. The SBE AC recognized Dr. Groves for his leadership as the SBE AC Chairperson for the past three years and acknowledged both Drs. Beall and Diamond for their many years of service to the SBE AC.

Dr. Lightfoot thanked Dr. Goodchild for accepting the SBE Chairperson position and stated that they will have a discussion about upcoming topics for the spring 2008 meeting. Additionally, Dr. Lightfoot announced that the Spring 2008 meeting will be held on June 12-13, 2008, and the fall meeting will be held on November 20-21, 2008. Dr. Goodchild approved these dates as the newly appointed Chairperson.

The meeting adjourned at 12:45 pm.