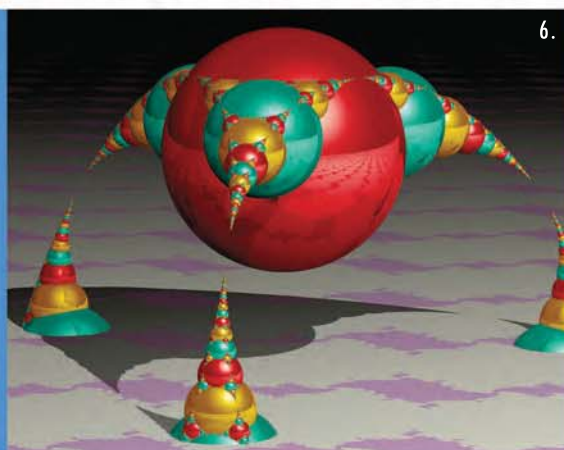
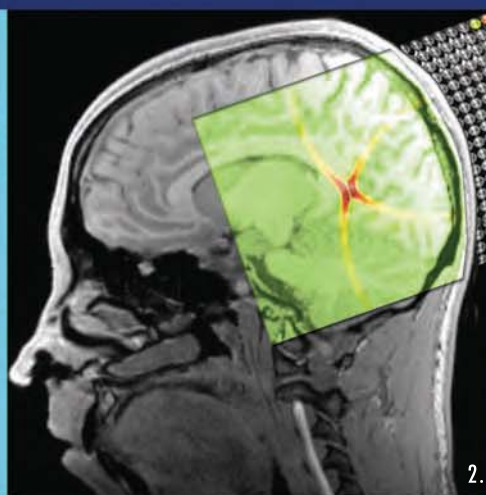


National Science Foundation's MERIT REVIEW CRITERIA

REVIEW AND REVISIONS



NATIONAL SCIENCE BOARD



Cover Images of NSF-Funded Research

1. **Arsenic Tolerant Plant.** The sporophyte of the fern *Pteris vittata*, which tolerates and accumulates very high levels of the deadly toxin arsenic. Researchers from Purdue University have identified a gene (ACR3) from *P. vittata* that is necessary for the plant's tolerance to arsenic. Jody Banks, professor of botany and plant pathology, and David Salt, professor of horticulture--both from Purdue University, discovered that the fern sucks the arsenic out of the soil and into its fronds. Banks sees the gene's potential in cleaning up environmental hazards, where plants could be created that can clean up soils and waters contaminated by arsenic.
2. **Sound Bullet.** Potential employment of a nonlinear acoustic lens to generate a sound bullet for hyperthermia procedures. The nonlinear acoustic lens was developed by Chiara Daraio, assistant professor of aeronautics and applied physics at Caltech, and postdoctoral scholar Alessandro Spadoni. The lens and its sound bullets have the potential to revolutionize applications from medical imaging and therapy to the nondestructive evaluation of materials and engineering systems.
3. **How do Carbon Nanotubes Grow?** The intimate mechanisms of carbon nanotube growth have provided scientists and engineers with a compelling puzzle for more than decade. Lack of experiments permitting the direct "viewing" of atomic-scale events--along with seemingly chaotic data from computer simulations, such as molecular dynamics--have added to this complex problem. Professor Boris Yakobson of Rice University and his research team have elucidated novel insight into nanotube growth by using mathematical models.
4. **Aurora borealis dances in the sky overtop Summit Station, located on the summit of the Greenland Ice Sheet.** Summit Station is home to the Greenland Environmental Observatory (GEOsummit), established by the National Science Foundation with cooperation from the government of Greenland. The station is located atop 3200 meters of ice and is nearly 400 kilometers from the nearest point of land. Summit supports a diversity of scientific research, including year-round measurements of air-snow interactions that provide crucial knowledge for interpreting data from deep ice cores drilled both at Summit and elsewhere.
5. **Prehistoric Coral.** A group of solitary horn corals, an extinct group of corals that belong to the Paleozoic evolutionary fauna. They are preserved in carbonate and are Ordovician in age (~450 million years old). They were found in southwestern Wisconsin. A National Science Foundation supported study by Shanan Peters, a University of Wisconsin-Madison assistant professor of geology and geophysics, found that changes in ocean environments related to sea level exert a driving influence on rates of extinction, which animals and plants survive or vanish, and generally determine the composition of life in the oceans. Since life began on Earth 3.5 billion years ago, scientists believe there may have been as many as 23 mass extinction events, and, during the past 540 million years, there have been five, well-documented mass extinctions, primarily of marine plants and animals, with as many as 75-95 percent of species lost.
6. **Mathematical Imagery.** Sphere's inversion transformations are the 3-D equivalent of circle inversions. Well-chosen initial spheres are iteratively inverted in well-chosen inversion spheres to obtain the (fractal) patterns in the images. This mathematical imagery was produced by *Jos Leys*.



**National Science Foundation's
Merit Review Criteria:
*Review and Revisions***

December 14, 2011

About the National Science Board

The National Science Board (Board) is composed of 24 presidentially appointed, Senate-confirmed Members. The Director of the National Science Foundation (NSF), an *ex officio* member, is the 25th Board member. The Board establishes the policies of NSF within the framework of applicable national policies set forth by the President and Congress. In this capacity, the Board identifies issues that are critical to NSF's future, approves NSF's strategic budget directions, approves annual budget submissions to the Office of Management and Budget, approves new programs and major awards, analyzes NSF's budget to ensure progress and consistency along the strategic direction set for NSF, and ensures balance between initiatives and core programs. The Board also serves as an independent policy advisory body to the President and Congress with a statutory obligation to "*...render to the President and the Congress reports on specific, individual policy matters related to science and engineering and education in science engineering, as the Board, the President, or the Congress determines the need for such reports*" and to "*render to the President and the Congress no later than January 15 of each even numbered year, a report on indicators of the state of science and engineering in the United States.*" (42 U.S.C. Section 1863) SEC.4.(j)(2) and (1).

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Member *ex officio*

- **Subra Suresh**, Director, National Science Foundation, Arlington, VA
-
- **Michael Van Woert**, Executive Officer, National Science Board, Arlington, VA

* *Consultant*

Members, NSB Task Force on Merit Review

- Dr. John T. Bruer, *Co-Chairman*
- Dr. Alan I. Leshner, *Co-Chairman*
- Dr. Louis J. Lanzerotti
- Dr. Douglas D. Randall
- Dr. Diane L. Souvaine
- Dr. Thomas N. Taylor
- Dr. Ray M. Bowen, *ex officio*
- Dr. Esin Gulari, *ex officio*
- Dr. Subra Suresh, *ex officio*
- Dr. Timothy Killeen, NSF Liaison Member
- Dr. Clifford Gabriel, NSF Liaison Member
- Dr. Joanne Tornow, Executive Secretary
- Ms. Kim Silverman, NSB Liaison

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December 14, 2011

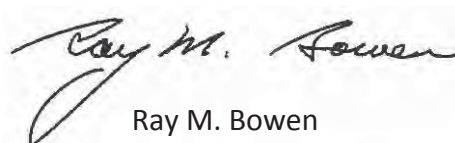
Memorandum from the Chairman of the National Science Board

Subject: NSF's Merit Review Criteria: Review and Revisions

At the February 2010 National Science Board (Board) meeting, the Board agreed that a review of the National Science Foundation's (NSF) Merit Review Criteria was a priority. Therefore, at that meeting the Board reconstituted the Task Force on Merit Review. The Task Force was charged with examining the two Merit Review Criteria and their effectiveness in achieving the goals for NSF support for science and engineering research and education. At that time, it was decided that this may include the possibility of revising the merit review methodology, and/or revising one or both of the Merit Review Criteria and the way they are interpreted and applied. Another possible outcome was that the Task Force could find that the methodology and criteria are clear and function as intended with no further changes or action required.

Ultimately, the Board did not change the two Merit Review Criteria, which remain Intellectual Merit and Broader Impacts. However, the Board did work to define more clearly the two Criteria in hopes that the NSF community has a better understanding of each criterion and how they relate to one another. The changes to the descriptions of the Criteria and the added Principles component are intended to enhance and clarify their function.

This report summarizes the decision-making process that yielded recommendations for a set of Principles and revised Merit Review Criteria, including the collection and analysis of data from the NSF staff and external research community that contributed to the Board-approved enhancements. NSF is now charged to implement the enhanced Merit Review Criteria, which affects every aspect of NSF's business. This important transition to using the re-defined Criteria is well underway and will be rolled out by NSF in subsequent months.



Ray M. Bowen
Chairman, National Science Board

Acknowledgments

The National Science Board (NSB, Board) is grateful to the many members of the NSF science and engineering research and education community, both internal and external, who generously contributed their perspectives on the existing Merit Review Criteria and provided thoughtful insight toward enhancement of the next iteration of the Criteria. We also thank those who responded to public comment opportunities on questions asked about the Criteria and in response to the proposed revision of the Criteria. Your suggestions were invaluable to the process and were given careful consideration.

The Board especially thanks NSF staff member, Dr. Joanne Tornow, Executive Secretary to the NSB Task Force on Merit Review, and Deputy Assistant Director in the Directorate for Social, Behavioral, and Economic Sciences (SBE). Dr. Tornow was instrumental in guiding the efforts of the Task Force through the many stages of the process, from review to the development of the Criteria language. The Board also thanks NSF staff member, Ms. Kim Silverman, Liaison to the Task Force and a Science Policy Analyst in the Board Office, for her critical role in developing the issue paper that led to the establishment of the Task Force and for her continued work with the Task Force and Dr. Tornow. As a team, they directed and managed all of the data-gathering and analysis activities, managed the day-to-day process of reviewing and revising the Criteria, and worked together to develop the report.

The Task Force consulted with a number of NSB and NSF staff members with specific expertise needed to help gather and analyze information on the use and utility of the Criteria and who subsequently helped shape the outcome. Special thanks go to the following NSF staff members (in alphabetical order):

- Dr. Robert Bell, Senior Analyst, SBE/National Center for Science and Engineering Statistics (NCSES)
- Dr. Anthony Cak, Program Specialist, Directorate for Biological Sciences (BIO)
- Mr. Evan Clinton, Student Intern, NSB Office (NSBO)
- Dr. Fran Featherston, Survey Statistician, SBE/NCSES
- Ms. Jean Feldman, Head, Office of Budget Finance and Award Management (BFA)/ Division of Institution and Award Support (DIAS)
- Ms. Ann Ferrante, Writer/Editor, NSBO
- Ms. Peggy Gartner, Branch Chief, Office of Information and Resource Management (OIRM)/Division of Administrative Services (DAS)
- Mr. Anthony Gibson, Acting Division Director, Division of Legislative Affairs, Office of the Director (OD)/Office of Legislative and Public Affairs (OLPA)
- Dr. Myron Gutmann, Assistant Director, SBE
- Dr. Fae Korsmo, Senior Advisor, OD
- Dr. Julia Lane, Program Director, SBE
- Ms. Jennie Moehlmann, Policy Branch Chief, NSBO

- Dr. Paul Morris, Staff Associate, OD/Office of Integrative Activities (OIA)
- Dr. William Neufeld, Education and Human Resources, Division of Research on Learning in Formal and Informal Settings
- Dr. Pamela O’Neil, Staff Associate, OD/OIA
- Ms. Suzanne Plimpton, Management Analyst, OIRM/DAS
- Ms. Erika Johnson-Rissi, Staff Associate, BFA/DIAS
- Dr. Judy Sunley, Interim Division Director, OIRM/Human Resource Management (HRM)
- Ms. Dana Topousis, Acting Division Director, Division of Public Affairs, OD/OLPA
- Dr. Michael Van Woert, Executive Office, NSBO
- Ms. Ellen Weir, Group Leader, Communications Services and Resources Group, OD/OLPA

Lastly, the NSB also expresses its appreciation for the assistance provided by SRI International’s Dr. Jongwon Park, Dr. Christina Freyman, and Dr. Thomas Slomba; Science and Technology Policy Institute’s Dr. Rachel Parker and Susannah Howieson; Dr. David Newman of Topicseek LLC; and Dr. Tim Mulcahy of NORC at the University of Chicago.

Executive Summary

In February 2010, the National Science Board (NSB, Board) established a Task Force on Merit Review, and charged it to review how well the current Merit Review Criteria used by the National Science Foundation (NSF) to evaluate all proposals were serving the agency. The two Criteria had been in place since 1997 with only one significant modification in 2007 (to include mention of potentially transformative concepts). The Task Force conducted a thorough review of data collected from multiple sources, which included extensive outreach to many stakeholder groups.

Based on the Task Force's analyses, NSB concluded that the two current Merit Review Criteria of Intellectual Merit and Broader Impacts remain appropriate for evaluating NSF proposals (the Board also recognized that the America COMPETES Reauthorization Act of 2010 included a provision mandating the retention of the Broader Impacts criterion). However, the Board concluded that revisions were needed; both to draw a clearer connection of the Criteria to core principles and to better articulate the essential elements of each criterion.

The implementation of the recommendations in this report is the responsibility of NSF staff. The Board expects timely reports on these implementation activities and looks forward to advising and supporting NSF in the implementation.

Merit Review Principles

Given that the NSF is the primary federal agency charged with nurturing and supporting excellence in basic research and education, the following three principles apply:

- All NSF projects should be of the highest quality and have the potential to advance, if not transform, the frontiers of knowledge.
- NSF projects, in the aggregate, should contribute more broadly to achieving societal goals. These "Broader Impacts" may be accomplished through the research itself, through activities that are directly related to specific research projects, or through activities that are supported by, but are complementary to, the project.
- Assessment and evaluation of NSF funded projects should be based on appropriate metrics, keeping in mind the likely correlation between the effect of broader impacts and the resources provided to implement projects. If the size of the activity is limited, evaluation of that activity in isolation is not likely to be meaningful. Thus, assessing the effectiveness of these activities may best be done at a higher more aggregated level than the individual project.

Merit Review Criteria

When evaluating NSF proposals, reviewers should consider what the proposers want to do, why they want to do it, how they plan to do it, how they will know if they succeed, and what benefits would accrue if the project is successful. These issues apply both to the technical aspects of the proposal and the way in which the project may make broader contributions. To that end, reviewers are asked to evaluate all proposals against two criteria:

- **Intellectual Merit:** The intellectual Merit criterion encompasses the potential to advance knowledge; and
- **Broader Impacts:** The Broader Impacts criterion encompasses the potential to benefit society and contribute to the achievement of specific, desired societal outcomes.

The following elements should be considered in the review for both criteria:

1. What is the potential for the proposed activity to
 - a. advance knowledge and understanding within its own field or across different fields (Intellectual Merit); and
 - b. benefit society or advance desired societal outcomes (Broader Impacts)?
2. To what extent do the proposed activities suggest and explore creative, original, or potentially transformative concepts?
3. Is the plan for carrying out the proposed activities well-reasoned, well-organized, and based on a sound rationale? Does the plan incorporate a mechanism to assess success?
4. How well qualified is the individual, team, or institution to conduct the proposed activities?
5. Are there adequate resources available to the PI (either at the home institution or through collaborations) to carry out the proposed activities?

Introduction and Background

The National Science Foundation (NSF, Foundation) is the Nation's premier agency supporting basic research and education in mathematics, science, engineering and technology. Its granting decisions are made on the basis of Merit Review by science and engineering peers. All NSF proposals, as part of the Merit Review process, are evaluated with respect to two equally important Merit Review Criteria—the Intellectual Merit of the project and the Broader Impacts of the work. The two-criterion system was instituted in 1997, replacing a four-criterion system in place since 1981, in which reviewers had evaluated researcher performance competence, intrinsic merit of the research, utility or relevance of the research, and effect on the infrastructure of science and engineering.

A recent article by the NSF historian, Dr. Mark Rothenberg, provides a comprehensive history of the evolution of NSF's merit review criteria from the inception of the agency (*Appendix I*). As noted in that article, the initial, single review criterion was “the scientific merit of the proposed research, including the competence of the investigator.” This criterion has been a mainstay for the Foundation, and continues to be a core element of the current Intellectual Merit criterion. However, Rothenberg also notes that right from the beginning, reviewers and NSF program officers were asked to consider several additional factors, including the uniqueness of the proposed research, the reasonableness of the budget, the quality of available resources at the institution, the relationship to the national effort, and demographics related to geographical and institutional distribution. Through subsequent revisions of the review criteria (in 1967, 1974, 1981, and 1997 (*see Appendix I for additional references*)), the basic concepts underlying the criteria did not change significantly, even as the number of criteria expanded and contracted and their descriptions evolved.

Current Merit Review Criteria

The two current review criteria were established by the Board and communicated via *Important Notice 121, New Criteria for NSF Proposals*, (www.nsf.gov/pubs/1997/iin121/) on July 10, 1997. As is noted in the text below (taken from IN 121), a set of contextual elements was established for each criterion, defined by questions to assist the reviewer and the proposer in understanding their intent. As the Notice stated:

1. What is the intellectual merit of the proposed activity?

The following are suggested questions to consider in assessing how well the proposal meets this criterion: *How important is the proposed activity to advancing knowledge and understanding within its own field and across different fields? How well qualified is the proposer (individual or team) to conduct the project? (If appropriate, please comment on the quality of prior work.) To what extent does the proposed activity suggest and explore creative and original concepts? How well conceived and organized is the proposed activity? Is there sufficient access to resources?*

2. What are the broader impacts of the proposed activity?

The following are suggested questions to consider in assessing how well the proposal meets this criterion: *How well does the activity advance discovery and understanding while promoting teaching, training, and learning? How well does the proposed activity broaden the participation of underrepresented groups (e.g., gender, ethnicity, geographic, etc.)? To what extent will it enhance the infrastructure for research and education, such as facilities, instrumentation, networks, and partnerships? Will the results be disseminated broadly to enhance scientific and technological understanding? What may be the benefits of the proposed activity to society?*

These criteria remained unchanged until 2007 when, at the culmination of a two-year effort by the NSB Task Force on Transformative Research, the Intellectual Merit criterion was modified to include a consideration of the degree to which the proposed research included potentially transformative concepts (as per *Important Notice 130: Transformative Research* (<http://www.nsf.gov/pubs/2007/in130/in130.jsp>)).

Rationale for Reviewing the Criteria

In the spring of 2010, the Board determined that it was time to take a fresh look at the definitions for the current criteria and the way they are applied to the NSF portfolio of increasingly complex and interdisciplinary projects. This became a priority for the Board for several reasons:

1. NSF was in the process of developing a new Strategic Plan ("[Empowering the Nation Through Discovery and Innovation - NSF Strategic Plan for Fiscal Years 2011-2016](#)"), and it would be valuable to ensure that the criteria were aligned with this plan.
2. NSF was aware of persistent anecdotal reports about confusion related to the Broader Impacts criterion, and inconsistency in how the criterion was being applied.

The Task Force on Merit Review was thus charged to examine the two criteria and their effectiveness in achieving NSF's goals for support of science and engineering research and education (*Appendix A*).

At the same time that the Task Force began its review, the U.S. Congress was writing the [America COMPETES Reauthorization Act of 2010](#) (ACRA), which provides reauthorization for the NSF. The Broader Impacts review criterion has been of interest to Congress over the years, and was specifically addressed in a separate section of the ACRA, which was signed into law on January 4, 2011. Section 526 of the Act establishes goals and policies for the Broader Impacts review criterion (*Appendix B*). The Act stipulated that NSF shall apply a Broader Impacts review criterion to achieve an array of societal goals. It also charged NSF to develop policies related to strategies and approaches employed to

address the Broader Impacts criterion; assessment and evaluation; institutional engagement in assisting investigators with activities associated with addressing broader impacts; and training to ensure NSF staff and potential NSF-supported investigators understand these new policies. Throughout its deliberations, the Task Force was mindful of this legislation, and worked to harmonize its findings with the goals and intent of ACRA Section 526.

Summary of Data Collection and Analysis

During its review of the Merit Review Criteria, the Task Force gathered data on how the Merit Review Criteria were being used. The Task Force solicited and received input from several stakeholder groups both internal and external to NSF, involving several thousand individuals.

The Task Force took great measures to ensure that information was gathered from a very broad audience. Specifically, input was gathered via interviews of NSF's external and internal stakeholders, through targeted and general surveys, data mining of archived NSF proposals using topic modeling techniques and data mining of information from past Committee of Visitors (COV) Reports.

The following is a brief summary of the methodology used for gathering stakeholder input—interviews, surveys, and topic modeling:

SRI International was contracted to design and implement a systematic approach to gathering and analyzing input from key stakeholder groups. The stakeholder groups were both external and internal to NSF. They included the Principal Investigators (PIs) and institutions that submit proposals for NSF research and education grants, reviewers of those proposals, NSF staff (including Senior Leadership, Division Leadership, and Program Directors), and Advisory Committee Members. SRI gathered stakeholder input on the use and utility of the NSF Merit Review Criteria as applied to the proposal and award process. Input was gathered through in-person interviews, phone interviews, and web surveys. Over 8,800 people were invited to share their opinions and 4,516 did so. Six major themes emerged during analysis of the responses. From these themes, the SRI team developed six recommendations (*Appendix C*).

In support of the larger study being conducted by SRI International, NSB contracted with the Science and Technology Policy Institute (STPI) to provide an analysis of responses to a public request for information related to the Merit Review Criteria. Specifically, on January 21, 2011, five questions were posed to the public on the NSB website as a means of gauging public and stakeholder perspectives on the Merit Review Criteria currently in place. STPI coded and analyzed the responses to the five open-ended questions using content analytic methods to refine the key themes emergent throughout the data (*Appendix D*).

All programs at NSF are reviewed by COVs on a three-year rotating basis, as part of NSF's larger Performance Assessment. The COVs are composed of external experts, who are convened for the purpose of assessing the integrity of the review process as carried out in individual programs, and the quality of the resulting portfolio of awards. As part of the review, the COV produces a public report, which is housed on the NSF web site at: <http://www.nsf.gov/od/oia/activities/cov/covs.jsp>. All COV reports for the

period 2001-2009 (total: 195) were analyzed for any issues raised by the COVS related to the use of the merit review criteria (*Appendix E*).

The Task Force believed that it was also important to examine how the Broader Impacts criterion was actually being interpreted and used by PIs, not simply how they reported using it. The Task Force enlisted the help of Topicseek LLC, to examine how Broader Impacts had been applied and discussed within a set of archived proposals. A preliminary topic modeling of Broader Impacts text was conducted on 150,000 proposal project summaries that spanned three years. A preliminary analysis of Broader Impacts topics by awarded/declined status was subsequently performed (*Appendix F*).

After reviewing the data, the Task Force drafted a set of guiding Principles and proposed revisions of the Merit Review Criteria (*Appendix G*), and then solicited feedback in June 2011 on these revisions from stakeholders. STPI was again asked to help, in coding and analyzing the responses using content analytic methods. The data provided valuable information for the Merit Review Task Force as it prepared its final recommendations (*Appendix H*).

Application and Interpretation of Current Merit Review Criteria

The analysis of all of these data revealed that the Intellectual Merit review criterion is well-understood by the community and NSF staff, but that the Broader Impacts criterion is not generally well understood. Moreover, while many benefits have resulted from the inclusion of the broader impacts criterion, this criterion has not always been consistently implemented by reviewers and NSF staff. Based on these data, and supported by the extensive stakeholder input, the Task Force determined that the two Merit Review Criteria—Intellectual Merit and Broader Impacts—are appropriate for evaluating NSF proposals and should be retained. The Task Force also determined, however, that revisions to the descriptions of the Broader Impacts criterion and how it is implemented are needed.

The major observations that emerged from the data gathering and analysis efforts are summarized below.

- The Intellectual Merit review criterion is well defined and clearly understood across all stakeholder groups. The elements that reviewers are asked to assess are for the most part concrete, and relate to technical/scientific elements of the proposal. The Intellectual Merit Criterion sets the standard for excellence for NSF proposals.
- The concept of the Broader Impacts criterion was praised by many stakeholders, who pointed to many benefits that have accrued as a result of instituting this criterion. However, there is a strong feeling that the execution of this criterion is flawed, and that the criterion is not well defined or clearly understood by the community. One manifestation of the confusion about this criterion was that many members of the community saw the potential considerations under the Broader Impacts criterion as a “check list” and believed that all elements needed to be included in every proposal.
- A substantial number of stakeholders believed that broadening participation of underrepresented groups was a critical component of Broader Impacts, and urged NSF to maintain this as a priority.
- All stakeholders gave more weight to the Intellectual Merit review criterion than to the Broader Impacts review criterion, including NSF program directors and division directors. However, NSF staff felt that reviewers should be giving more consideration to the Broader Impacts than they are currently doing.

- Many believed that the broader impacts criterion has changed how people think about the scientific process, but that assessing the effectiveness of broader impacts would be more meaningful if they were aggregated at a higher level than the individual project.
- With respect to assessment of outcomes, there was agreement that current methods for assessing intellectual merit are adequate (publications, etc.). On the other hand, the data suggested that the methods for assessing the outcomes from broader impacts are unclear and inconsistent across projects and institutions. There was a strong sense that NSF should be doing more to facilitate assessment of whether or not the goals of the Broader Impacts criterion are being realized.
- A large majority of stakeholders believed that institutions could do more to support the PIs' efforts related to meeting the Broader Impacts criterion. For example, institutions could facilitate the establishment of connections -- among PIs engaged in similar activities, or between PIs and established programs or organizations with similar interests, etc., -- coordinate assessment activities, or provide other types of supporting services that could enhance the PI's efforts.

Recommendations

NSF is the premier federal agency charged with nurturing and supporting excellence in basic research. With that in mind, NSB reiterates its commitment to the principle that all NSF projects should be of the highest quality and have the potential to advance the frontiers of knowledge. The Board similarly reaffirms its commitment to the concept that, in the aggregate, NSF projects should contribute more broadly to advancing societal goals. These “Broader Impacts” may be achieved through the research itself, through activities that are directly related to specific research projects, or through activities that are supported by, but are complementary to, the project.

NSB also believes that appropriate assessment mechanisms for understanding the value of broader impacts activities should be incorporated, keeping in mind that assessing the effect of these activities one project at a time is not likely to be meaningful, particularly if the size of the activity is limited. Assessing the effectiveness of activities designed to contribute more broadly to advancing societal outcomes may best be done at a higher, more aggregated, level than the individual project.

In the final analysis, NSB believes that the Intellectual Merit and Broader Impacts review criteria together capture the important elements that should guide the evaluation of NSF proposals. Because of the great breadth and diversity of research and education activities that are supported by NSF, the Board has decided not to recommend a specific set of activities related to Broader Impacts, just as it would not recommend particular types of research— those decisions are best left to the PIs to describe and to the NSF to evaluate, for relevance to programmatic priorities and alignment with NSF’s core strategies for achieving its mission, as described in the NSF Strategic Plan for FY 2011-2016 “[Empowering the Nation Through Discovery and Innovation](#).”

- Be a leader in envisioning the future of science and engineering.
- Integrate research and education and build capacity.
- Broaden participation in the science and engineering research and education enterprises.
- Learn through assessment and evaluation of NSF programs, processes, and outcomes.

Nonetheless, the Board recognizes the importance of providing a context within which the users of these criteria can better understand their intent. To that end, NSB has articulated principles upon which the two Merit Review Criteria are based. As the community continues to use these criteria in developing and evaluating NSF proposals, the following principles should be kept in mind.

Merit Review Principles

NSF strives to invest in a robust and diverse portfolio of projects that creates new knowledge and enables breakthroughs in understanding across all areas of science and engineering research and education. To identify which projects to support, NSF relies on a merit review process that incorporates consideration of both the technical merits of a proposed project and its potential to contribute more broadly to advancing NSF's mission "to promote the progress of science; to advance the national health, prosperity, and welfare; to secure the national defense; and for other purposes." In 1997, these two considerations were put into action through the two primary merit review criteria of Intellectual Merit and Broader Impacts.

The importance of considering potential broader impacts in the process of deciding which projects to fund was re-emphasized in the America COMPETES Reauthorization Act of 2010. This legislation identifies a number of societally relevant outcomes, to which NSF-funded research can contribute. Similarly, the NSF Strategic Plan emphasizes the value of broader impacts of scientific research, beyond the intrinsic importance of advancing scientific knowledge. These outcomes include (but are not limited to) increased participation of women, persons with disabilities, and underrepresented minorities in science, technology, engineering, and mathematics (STEM); improved STEM education at all levels; increased public scientific literacy and public engagement with science and technology; improved well-being of individuals in society; development of a globally competitive STEM workforce; increased partnerships between academia, industry, and others; increased national security; increased economic competitiveness of the United States; and enhanced infrastructure for research and education. These examples of societally relevant outcomes should not be considered either comprehensive or prescriptive. Investigators may include appropriate outcomes not covered by these examples.

Given that the NSF is the primary federal agency charged with nurturing and supporting excellence in basic research and education, the following three principles apply:

- All NSF projects should be of the highest quality and have the potential to advance, if not transform, the frontiers of knowledge.
- NSF projects, in the aggregate, should contribute more broadly to achieving societal goals. These "Broader Impacts" may be accomplished through the research itself, through activities that are directly related to specific research projects, or through activities that are supported by, but are complementary to, the project.

- Meaningful assessment and evaluation of NSF funded projects should be based on appropriate metrics, keeping in mind the likely correlation between the effect of broader impacts and the resources provided to implement projects. If the size of the activity is limited, evaluation of that activity in isolation is not likely to be meaningful. Thus, assessing the effectiveness of these activities may best be done at a higher, more aggregated, level than the individual project.

With respect to the final principle, the Board emphasizes that, even if assessment of Broader Impacts outcomes for particular projects is done at an aggregated level, PIs are expected to be accountable for carrying out the activities described in the funded project. Thus, individual projects should include clearly stated goals, specific descriptions of the activities that the PI intends to do, and a plan in place to document the outputs of those activities.

Merit Review Criteria

When evaluating NSF proposals, reviewers should consider what the proposers want to do, why they want to do it, how they plan to do it, how they will know if they succeed, and what benefits would accrue if the project is successful. These issues apply both to the technical aspects of the proposal and the way in which the project may make broader contributions. To that end, reviewers are asked to evaluate all proposals against two criteria:

- **Intellectual Merit:** The intellectual Merit criterion encompasses the potential to advance knowledge; and
- **Broader Impacts:** The Broader Impacts criterion encompasses the potential to benefit society and contribute to the achievement of specific, desired societal outcomes.

The following elements should be considered in the review for both criteria:

1. What is the potential for the proposed activity to
 - a. advance knowledge and understanding within its own field or across different fields (Intellectual Merit); and
 - b. benefit society or advance desired societal outcomes (Broader Impacts)?
2. To what extent do the proposed activities suggest and explore creative, original, or potentially transformative concepts?
3. Is the plan for carrying out the proposed activities well-reasoned, well-organized, and based on a sound rationale? Does the plan incorporate a mechanism to assess success?
4. How well qualified is the individual, team, or institution to conduct the proposed activities?
5. Are there adequate resources available to the PI (either at the home institution or through collaborations) to carry out the proposed activities?

Guidance to NSF on the Application of the Revised Criteria

NSF should now develop an implementation plan for applying the two merit review criteria, so that there is a clear and consistent understanding of the underlying principles inherent in the criteria, and how they should be used during the review and decision-making processes. During its deliberations, the Task Force identified several important issues related to the use of the criteria, and the Board recommends that NSF pay particular attention to addressing these issues in the development of its implementation plan.

1. NSF should make clear its expectation that both criteria are important and should be given full consideration during the review and decision-making processes; each criterion is necessary but neither is sufficient. Specific actions that should be taken include:
 - a. Modify the Grant Proposal Guide so that:
 - i. For all proposals, require a separate section in the Project Description that describes the Broader Impacts of the proposed activities.
 - ii. For renewal proposals, require that the “Results of Prior Support” describe accomplishments related to both criteria in separate sections.
 - b. All decision documents produced by NSF staff should describe how the project addresses both criteria.
 - c. Enforce the requirement that all public award abstracts describe how the project addresses both criteria.
 - d. Annual and final project report templates should be changed to explicitly address progress in all activities of the project, including any activities intended to address the Broader Impacts criterion that are not intrinsic to the research.
2. New guidance to PIs, reviewers, and NSF staff on the intent and review elements of the review criteria should be developed and broadly distributed.
3. NSF should develop a set of Frequently Asked Questions (FAQs) for both review criteria, addressing the most common areas of misunderstanding. Because many PIs interact with multiple units within NSF, it is important that these FAQs incorporate the “OneNSF” concept, to increase consistent use of the criteria across the agency and to reduce confusion in the community.
4. Just as institutions play an important role in facilitating research-related activities of their investigators, often in ways that align with strategic departmental and institutional (and possibly state-wide, regional, or national) priorities and investments, such a role can extend to activities directed toward

the broader impacts of the project as well. Indeed, some such efforts might be more effective if coordinated appropriately in ways that leverage particular institutional assets or strategic directions and even link investigators from multiple projects. NSF should encourage institutions to pursue such cooperative possibilities, which have the dual benefit of retaining the contributions of individual investigators while addressing national goals and yielding benefits broader than those within a given project.

5. NSF should make clear that it expects PIs to be accountable for carrying out the activities described in the funded project intended to address the Broader Impacts criterion, i.e., there is an expectation that within individual projects, there are clearly stated goals, specific descriptions of the PI's intended activities, and a plan in place to document the results. Nonetheless, NSB notes that assessing the effectiveness and impact of outcomes of these activities one project at a time may not be meaningful, particularly if the size of the activity is limited. Thus, assessing the effectiveness of activities designed to advance broader societal goals may best be done at a higher, more aggregated, level than the individual project. Large campus-wide activities or aggregated activities of multiple PIs could lend themselves to assessment, which should be supported by NSF. Thus, NSF should not require all PIs to include evaluation costs in the budget for every project, but instead should provide guidance on when project-level assessment would be appropriate, what broader impacts data are important for future assessment purposes, and when assessment at a program or institutional level would be more reasonable.
6. The two Board-approved Merit Review Criteria form the basis of the review of all NSF proposals. The use of additional review criteria may be appropriate for some solicitations, where there are specific requirements that are not explicitly captured in these two criteria. NSF should look carefully at the circumstances under which the use of additional criteria would be appropriate, and develop guidance for NSF staff to use when developing new solicitations.

Conclusion

In this report, the Board reiterates its commitment to the principle that all NSF projects should be of the highest quality and have the potential to advance the frontiers of knowledge. In addition, all projects should have societal impacts that go beyond the technical aspects of the project alone. For these reasons, the Board believes that the two criteria that have directed NSF's merit review process have served it well and should be retained.

During the course of the Task Force's review of the two Merit Review Criteria—Intellectual Merit and Broader Impacts—it became clear that revisions were needed to clarify the meaning of the Criteria and how they are applied. As well, it was important to draw a direct connection to NSF's core principles. Those revisions are the subject of this report.

The NSB objective in this effort is intended to promote greater advances in science and to help the U.S. science enterprise contribute even more to achieving important societal goals. By providing this guidance, the Board hopes that the revisions made to the descriptions of the Merit Review Criteria and the inclusion of the Merit Review Principles component will enhance the use of the Criteria and aid NSF in achieving its goals of promoting excellence in basic science and engineering research and education in the U.S.

Appendices

- A. Charge to the Task Force on Merit Review
- B. Section 526 of the America COMPETES Reauthorization Act
- C. SRI Summary Report of Interview and Survey Results of Stakeholder Input
- D. STPI Summary Report of Web Site Comments
- E. Analysis of COV reports
- F. Topic Modeling and Analysis of NSF's Broader Impacts Criterion
- G. First Revision of the Criteria
- H. STPI Summary Report of Responses to First Revision of the Criteria
- I. Making Judgments about Grant Proposals: A Brief History of the Merit Review Criteria at the National Science Foundation

Appendix A

Charge to the Task Force on Merit Review

**NATIONAL SCIENCE BOARD
TASK FORCE ON MERIT REVIEW**

National Science Foundation
May 4, 2010

Background

All National Science Foundation (NSF) proposals, as part of the Merit Review process, are evaluated with respect to two equally important Merit Review Criteria—Intellectual Merit and Broader Impacts. The two-criteria system was instituted in 1997, replacing a four-criteria system in place since 1981, in which reviewers had evaluated researcher performance competence, intrinsic merit of the research, utility or relevance of the research, and effect on the infrastructure of science and engineering. The new system was implemented after careful study by the National Science Board /NSF Staff Task Force on Merit Review whose report, *National Science Board and National Science Foundation Staff Task Force on Merit Review: Discussion Report*, was released for community comment in November 1996, after which it was revised and approved by the Board in March 1997. At that time, a set of contextual elements was established for each of the two criteria and defined by questions to assist the reviewer in understanding their intent. These elements were seen as not necessarily relevant or complete for the evaluation of all proposals; other considerations may be important for the evaluation of some proposals. Additionally, reviewers were requested to address only those elements that they consider relevant to the proposal at hand and for which they feel qualified to pass judgment. The new system was communicated to the research community via *Important Notice 121, New Criteria for NSF Proposals*, (<http://www.nsf.gov/pubs/1997/iin121/>) on July 10, 1997 and implemented October 1, 1997.

Several years later, the NSB was requested by Congress to conduct a review of the NSF merit review process. The Board conducted the review and issued its report in September 2005, concluding that the NSF merit review process is fair and effective, and “remains an international ‘gold standard’ for review of science and engineering research proposals.” In the report, the Board provided several recommendations for NSF to improve the transparency and effectiveness of the NSF merit review process, while preserving the ability of the program officers to identify the most innovative proposals and effectively diversify and balance NSF's research and education portfolio. (*FY 2005 Report on the NSF Merit Review System*: http://www.nsf.gov/nsb/documents/2006/0306/merit_review.pdf). In response to the Board's recommendations, NSF implemented an agency-wide effort to address quality of reviews, transparency of the award/decline decision, and support of transformative research. (*Report to the National Science Board on the National Science Foundations' Merit Review Process FY 2005*: http://www.nsf.gov/nsb/documents/2006/0306/merit_review.pdf)

Charge to the NSB Task Force on Merit Review

Five years have passed since the last review of the Merit Review process and a new National Science Foundation Strategic Plan will be issued shortly. Moreover, the current review criteria have now been in effect for over a decade, and in light of reports of some confusion in the field and inconsistency of their application and impact, it is timely for the National Science Board both to evaluate the current criteria with respect to their definitions and the way they are applied to the NSF portfolio of increasingly complex and interdisciplinary projects, and to ask whether the Merit Review process could be enhanced or modified, by clarifying or amending the statements of the Merit Review Criteria.

The NSB Task Force on Merit Review is hereby reconstituted at the February 3-4, 2010 National Science Board meeting. The Task Force is charged with examining the two Merit Review Criteria and their effectiveness in achieving the goals for NSF support for science and engineering research and education. This may include revising the merit review methodology, revising one or both of the merit review criteria and the way they are interpreted and applied, or the task force may find that the methodology and criteria are clear and function as intended with no further changes or action required.

The first steps are for the Board and NSF senior staff to identify relevant data sources, to define the issues, and outline possible options to make the use of review criteria more effective in meeting NSF's mission. **A work plan should be submitted to the Board at its May 2010 meeting with the goal of a report with policy recommendations at the May 2011 meeting.** During that one-year period, the Task Force should solicit input widely from the research and stakeholder communities and may solicit special studies as appropriate.

Membership on the NSB Task Force on Merit Review are NSB members: Dr. Alan Leshner, Chairman, Dr. Ray Bowen, Dr. John Bruer, Dr. Esin Gulari, Dr. Lou Lanzerotti, Dr. Douglas Randall, Dr. Diane Souvaine, Dr. Thomas Taylor, and NSF Liaison members on the Task Force, Dr. Lance Haworth, Dr. Tim Killeen, and Mr. Jeff Nesbit.

NSB Task Force on Merit Review Work Plan

Process and Strategies

This work plan describes the process and strategies for gaining input from stakeholders regarding their understanding of the NSF merit review criteria as applied to the proposal and award process, analyzing and discussing the findings, and working with NSF leadership.

The stakeholder groups are both internal and external to NSF and mainly include research communities and their institutions (external) and NSF program officers (internal). The input gained from this study will inform the task force on how best to proceed with follow-up action, which includes detailing the findings, deliberating recommendations, discussing recommendations with NSF leadership, and working together to find the best solutions. This may include revising the merit review methodology, revising one or both of the merit review criteria and the way they are interpreted and applied, or the task force may find that the methodology and criteria are clear and function as intended with no further changes or action required.

The first steps are for the task force to identify relevant data sources, to define the issues, and outline possible options to make the use of the merit review criteria more effective in meeting NSF's mission.

The steps in the process are as follows:

1. **Determine the way the current criteria, and their instructions, are interpreted and utilized by both proposers and NSF program staff.**
 - Survey program officers and NSF leadership - The goal of this internally-focused survey is to gain broad insight as to how program officers apply the criteria when 1) advising Principal Investigators on how they address the criteria within their proposals and 2) directing their reviewers in determining to what extent the criteria has been met within each proposal.
 - Solicit and collect feedback from principal investigators and institutional research officials
2. **Integrate survey input, summarize findings and deliberate recommendations.**
3. **Create draft recommendations and vet with NSF internal and external stakeholder groups that may include NSF staff, university administration, policymakers, OSTP, and Congress.**
4. **Produce and publish a Task Force Report disclosing the process, strategies, findings and recommendations for the NSF Merit Review process going forward. (Report due by May 2011.)**

NSB Merit Review Task Force Timeline

Date	Task
March 2010	Task Force teleconference to discuss work plan and finalize draft Task Force charge
March – May 2010	Task Force members develop a plan of action—determine the questions they want answered; the information necessary to attain the answers; and the means by which to gather the information
May 4-5, 2010	Task Force meeting at Board meeting to discuss next steps in proceeding with the internal and external survey (or study)
May – August 2010	Design and implementation of internal survey to program officers
May – Dec. 2010	Design, clearance, and implementation of external survey to Principal Investigators (Note: Approximately 6-9 months is needed for survey development and the required OMB clearance process for external surveys)
August 25-26, 2010	Task Force meeting at Board meeting to discuss progress on the surveys and results of the internal survey to NSF program officers
August – Sept. 2010	Review and compile findings from internal survey
September 2010	Offsite Board meeting/Informal discussion of progress
Sept. – Dec. 2010	Complete analysis of internal survey findings and begin to formulate recommendations
Dec. 1-2, 2010	Task Force meeting at Board meeting to review and discuss results of external survey
Dec. – Feb. 2011	Complete analysis for external survey, form draft recommendations and vet recommendations with NSF internal and external stakeholders
Feb. – May 2011	Draft final report with findings and recommendations for merit review criteria

REVIEW-IN-BRIEF OF THE CURRENT CRITERIA

Intellectual Merit

A critical criterion for NSF's funding of research has been the proposed project's intellectual merit, both in overall quality and in significance to the broader field. A concern has arisen over the past few years, however, that the current system is missing the importance of some more transformative (often also called high-risk, high-payoff) research and that the system has become a bit more conservative as funds have become more constrained, despite efforts by NSF to emphasize transformative research. (See Important Notice No. 130: Transformative Research, Sept. 2007: <http://www.nsf.gov/pubs/2007/in130/in130.jsp>). In light of the report of the NSB's Task Force on Transformative Research and the recommendation of the Companion Piece to *Science and Engineering Indicators 2010, Globalization of Science and Engineering Research* (NSB 10-3), namely "The National Science Foundation should assess its two criteria for funding of S&E research to ensure that the criteria encourage the proposing and support of truly transformative research, and should modify the criteria and/or merit review process if the assessment finds modifications necessary to accomplish this goal," special consideration should be given to whether the current criteria and their implementation are accomplishing the goal of supporting the best of all kinds of research.

Broader Impacts

The Broader Impacts criterion identifies the important outcomes and consequences of NSF-supported research. Anecdotal evidence suggests that this requirement can be very confusing to the research community, which continues to express frustration in interpreting and thus responding effectively to the Broader Impacts criterion when creating a proposal. In July 2007, *Merit Review Broader Impacts Criterion: Representative Activities* (<http://www.nsf.gov/pubs/gpg/broaderimpacts.pdf>) was made available to PIs in the *Grant Proposal Guide*, which includes examples of ways that broader impacts could be incorporated into research projects. These examples are quite diverse but that diversity can also make them confusing to proposers and to NSF program staff attempting to address the Broader Impacts criterion in the review and decision process. There also is concern that these examples can appear to be directive yet are not fully inclusive. For example, they do not fully reflect the importance of impacts on such issues as innovation, national security and economic growth. Finally, there appears to be substantial confusion about how best to meet the requirements of this criterion, whether on an individual project level or at the proposing institution level.

Appendix B

Section 526 of the America COMPETES Reauthorization Act

- (1) collaborate with industry in the development of standards supporting trusted cloud computing infrastructures, metrics, interoperability, and assurance; and
- (2) support standards development with the intent of supporting common goals.

SEC. 525. TRIBAL COLLEGES AND UNIVERSITIES PROGRAM.

(a) **IN GENERAL.**—The Director shall continue to support a program to award grants on a competitive, merit-reviewed basis to tribal colleges and universities (as defined in section 316 of the Higher Education Act of 1965 (20 U.S.C. 1059c), including institutions described in section 317 of such Act (20 U.S.C. 1059d), to enhance the quality of undergraduate STEM education at such institutions and to increase the retention and graduation rates of Native American students pursuing associate's or baccalaureate degrees in STEM.

(b) **PROGRAM COMPONENTS.**—Grants awarded under this section shall support—

- (1) activities to improve courses and curriculum in STEM;
- (2) faculty development;
- (3) stipends for undergraduate students participating in research; and
- (4) other activities consistent with subsection (a), as determined by the Director.

(c) **INSTRUMENTATION.**—Funding provided under this section may be used for laboratory equipment and materials.

SEC. 526. BROADER IMPACTS REVIEW CRITERION.

(a) **GOALS.**—The Foundation shall apply a Broader Impacts Review Criterion to achieve the following goals:

- (1) Increased economic competitiveness of the United States.
- (2) Development of a globally competitive STEM workforce.
- (3) Increased participation of women and underrepresented minorities in STEM.
- (4) Increased partnerships between academia and industry.
- (5) Improved pre-K–12 STEM education and teacher development.
- (6) Improved undergraduate STEM education.
- (7) Increased public scientific literacy.
- (8) Increased national security.

(b) **POLICY.**—Not later than 6 months after the date of enactment of this Act, the Director shall develop and implement a policy for the Broader Impacts Review Criterion that—

- (1) provides for educating professional staff at the Foundation, merit review panels, and applicants for Foundation research grants on the policy developed under this subsection;
- (2) clarifies that the activities of grant recipients undertaken to satisfy the Broader Impacts Review Criterion shall—
 - (A) to the extent practicable employ proven strategies and models and draw on existing programs and activities; and
 - (B) when novel approaches are justified, build on the most current research results;
- (3) allows for some portion of funds allocated to broader impacts under a research grant to be used for assessment and evaluation of the broader impacts activity;

(4) encourages institutions of higher education and other nonprofit education or research organizations to develop and provide, either as individual institutions or in partnerships thereof, appropriate training and programs to assist Foundation-funded principal investigators at their institutions in achieving the goals of the Broader Impacts Review Criterion as described in subsection (a); and

(5) requires principal investigators applying for Foundation research grants to provide evidence of institutional support for the portion of the investigator's proposal designed to satisfy the Broader Impacts Review Criterion, including evidence of relevant training, programs, and other institutional resources available to the investigator from either their home institution or organization or another institution or organization with relevant expertise.

SEC. 527. TWENTY-FIRST CENTURY GRADUATE EDUCATION.

(a) **IN GENERAL.**—The Director shall award grants, on a competitive, merit-reviewed basis, to institutions of higher education to implement or expand research-based reforms in master's and doctoral level STEM education that emphasize preparation for diverse careers utilizing STEM degrees, including at diverse types of institutions of higher education, in industry, and at government agencies and research laboratories.

(b) **USES OF FUNDS.**—Activities supported by grants under this section may include—

(1) creation of multidisciplinary or interdisciplinary courses or programs for the purpose of improved student instruction and research in STEM;

(2) expansion of graduate STEM research opportunities to include interdisciplinary research opportunities and research opportunities in industry, at Federal laboratories, and at international research institutions or research sites;

(3) development and implementation of future faculty training programs focused on improved instruction, mentoring, assessment of student learning, and support of undergraduate STEM students;

(4) support and training for graduate students to participate in instructional activities beyond the traditional teaching assistantship, and especially as part of ongoing educational reform efforts, including at pre-K–12 schools, and primarily undergraduate institutions;

(5) creation, improvement, or expansion of innovative graduate programs such as science master's degree programs;

(6) development and implementation of seminars, workshops, and other professional development activities that increase the ability of graduate students to engage in innovation, technology transfer, and entrepreneurship;

(7) development and implementation of seminars, workshops, and other professional development activities that increase the ability of graduate students to effectively communicate their research findings to technical audiences outside of their own discipline and to nontechnical audiences;

(8) expansion of successful STEM reform efforts beyond a single academic unit to other STEM academic units within an institution or to comparable academic units at other institutions; and

Appendix C

SRI Summary Report of Interview and Survey Results of Stakeholder Input

SRI International

Review of Merit Review Criteria: Summary Report of Stakeholder Input

**Prepared for the National Science Board Task Force on Merit Review by
Christina Freyman, Tom Slomba, Jongwon Park, Lori Thurgood, and Prudy Brown
SRI International**

September 2011



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Executive Summary

All National Science Foundation (NSF) proposals, as part of the merit review process, are evaluated with respect to two Merit Review criteria – Intellectual Merit and Broader Impacts. The two-criteria system was instituted in 1997, replacing a four-criteria system in place since 1981. In the *Grant Proposal Guide*, NSF provides a list of potential considerations for merit review for each criterion. The National Science Board Task Force on Merit Review has been charged with examining the two Merit Review criteria and the Merit Review criteria’s effectiveness in achieving the NSF goals to support science and engineering research and education. The Task Force is authorized to consider a broad array of options, ranging from a complete revision of the Merit Review criteria to reaffirmation of the criteria in their current form. Various modifications of one or both of the Merit Review criteria and the way they are interpreted and applied are also possible.

To assist the Task Force, SRI designed and implemented a systematic approach to gather and analyze input from key stakeholder groups. The stakeholder groups were both external and internal to NSF. They included the principal investigators and institutions that submit proposals for NSF research and education grants, reviewers that review those proposals, and NSF Leadership, Officials, and Advisory Committee Members. SRI gathered stakeholder input on the use and utility of the NSF Merit Review criteria as applied to the proposal and award process. Input was gathered through in-person interviews, phone interviews, and web surveys. Over 8,800 people were invited to share their opinions and 4,516 did so. Six major themes emerged during analysis of the responses. From these themes, the SRI team developed six recommendations.

Themes

Theme 1. The Intellectual Merit criterion is clearly defined and generally well understood, although there are some concerns related to the consideration of “transformative concepts” of proposed research and the level of emphasis placed on the qualification of the principal investigator.

Theme 2. The Broader Impacts criterion goals are good; however, there is a lack of understanding of the criterion that calls for improved guidance.

Theme 3. The Intellectual Merit criterion is and should be weighted more than the Broader Impacts criterion during proposal review, but guidance is lacking.

Theme 4. Principal investigators’ institutions should play a greater role in supporting Broader Impacts activities, and there are some steps NSF could take to encourage this.

Theme 5. Post-award assessment of the Broader Impacts activities of NSF awards is weak and could be improved.

Theme 6. The Merit Review criteria appear to have impacted how scientists think about their research.

Recommendations

1. NSF should standardize the definition and application of the potential considerations that focus on “transformative research” and “qualifications of the principal investigator”.

Based on Theme 1.

2. NSF should add information in the guidance on the types and amount of activities and the level of effort expected for Broader Impacts activities.

Based on Theme 2.

3. NSF should provide better guidance about the use of the two criteria in the review process, including relative weight of each criterion.

Based on Theme 3.

4. NSF should enable and encourage institutional support for principal investigator’s Broader Impacts activities.

Based on Theme 4.

5. NSF should improve assessment of Broader Impacts activities.

Based on Theme 5.

Introduction

All National Science Foundation (NSF) proposals, as part of the Merit Review process, are evaluated with respect to two Merit Review criteria – Intellectual Merit and Broader Impacts. The two-criteria system was instituted in 1997, replacing a four-criteria system in place since 1981. In the *Grant Proposal Guide*, published at the NSF webpage¹ on October 1, 2010, NSF provides a list of potential considerations for each Merit Review criterion. The five considerations for each criterion are presented in Appendix A. Two major revisions to the Merit Review criteria have occurred since they were implemented in 1997. Prior to 2001, principal investigators were encouraged to address the broader impacts of their proposed work; however, since 2001, NSF has required that proposals include a specific statement on Broader Impacts activities. Proposals lacking such a statement are returned as incomplete. In 2007, “potentially transformative” was added to the list of potential considerations for the Intellectual Merit criterion, as follows: “To what extent does the proposed activity suggest and explore creative, original, or potentially transformative concepts?”

The National Science Board (NSB) Task Force on Merit Review has been charged with examining the two Merit Review criteria and the Merit Review criteria’s effectiveness in achieving the NSF goals to support science and engineering research and education. The Task Force is authorized to consider a broad array of options, ranging from a complete revision of the Merit Review criteria to reaffirmation of the criteria in their current form. Various modifications of one or both of the Merit Review criteria and the way they are interpreted and applied are also possible.

A critical part of the Task Force’s work plan was to gain input from a variety of stakeholders regarding the application and level of understanding of the NSF Merit Review criteria in the proposal and award process. The stakeholder groups were both external and internal to NSF – they included the principal investigators and representatives of institutions that submit proposals for NSF research and education awards, reviewers that review those proposals, and NSF Leadership, NSF Program Officers, and NSF Advisory Committee Members. NSF Advisory Committee Members are field experts drawn from outside NSF and serve to advise their host directorate or office for a three-year term. The stakeholder input presented in this report is meant to inform the Task Force’s deliberations and recommendations.

¹ http://www.nsf.gov/pubs/policydocs/pappguide/nsf11001/gpg_index.jsp

Scope

SRI used two data collection strategies – interviews and web surveys – to obtain input regarding NSF’s Merit Review criteria from a variety of stakeholder groups.

Stakeholder input was sought to address the following seven general questions:

- ✓ Are the two Merit Review criteria clearly explained?
- ✓ How are the Merit Review criteria being interpreted by principal investigators, reviewers, NSF staff?
- ✓ How are the two Merit Review criteria weighted by principal investigators, reviewers, NSF staff?
- ✓ What are the strengths and weaknesses of the current criteria?
- ✓ Have the criteria had an impact on the way principal investigators think about shaping their research projects?
- ✓ What is the appropriate role of the principal investigator’s institution?
- ✓ How can the outcomes of activities relevant to each criterion be assessed?

The stakeholder groups included:

- ✓ NSF Senior Leadership consisting of Assistant Directors and Deputy Assistant Directors of NSF Directorates and Directors and Deputy Directors of NSF Offices
- ✓ University and College Representatives
- ✓ NSF Officials consisting of NSF Program Officers, Division Directors, and Deputy Division Directors
- ✓ NSF Advisory Committee Members
- ✓ Principal Investigators
- ✓ Reviewers including both Panel Reviewers and Ad-Hoc Reviewers

Methodology

Interviews conducted in person or over the phone were used to obtain input from NSF Senior Leadership and representatives from nine selected colleges and universities. Two web surveys were used to gather input from the other stakeholder groups. The input was collected between November 2010 and April 2011.

Interviews with NSF Senior Leadership

Members of the NSF Senior Leadership of the seven NSF Directorates and seven NSF Offices were invited to participate in the interviews. Twenty-two leaders from 12 organizational units were able to participate in the interviews, which were conducted in person during November 2010. A more detailed description of the interview methodology, a copy of the interview guide, and a list of participants are provided in Appendix B with the detailed summary of the interviews.

Interviews with University and College Representatives

Interviews were conducted with representatives of nine universities and colleges. These institutions were selected to represent a cross-section of schools that receive NSF funding – different sizes, types, and a variety of geographic locations. The interviews were conducted during January and February 2011, either in person or over the phone. A more detailed description of the interview methodology, a copy of the interview guide, and a list of participants are provided in Appendix C with the detailed summary of the interviews. Because of the nature and small size of the sample, the views and experiences of these representatives interviewed cannot be generalized to all college and university officials. Information on their views and experiences are included to exemplify or illustrate themes that emerged from input obtained from the other stakeholder groups.

Survey of NSF Officials and NSF Advisory Committee Members

This survey's frame consisted of all current NSF Officials defined as Program Officers, Division Directors, and Deputy Division Directors (581 individuals) and Advisory Committee Members (234 individuals) as provided to SRI by NSF in January 2011. The entire universe was invited to participate in a web survey. The survey questionnaire was developed and refined in consultation with NSF and NSB staff working with the NSB Task Force on Merit Review. The survey was pretested with six individuals. Survey invitees received a presurvey email from the NSB Task Force on Merit Review, and a survey invitation plus 3 reminders from SRI. The preliminary email and the survey invitation included assurances that there would be no individual attribution to any survey response and that SRI as the survey administrator would maintain the confidentiality of all respondents. The survey remained open from January 28, 2011 to February 18, 2011. Usable responses were obtained from 385 NSF Officials and 111 Advisory Committee Members for response rates of 66% and 47% respectively. The overall response rate was 64%. The responses of NSF Program Officers, Division Directors, and Deputy Division Directors are presented together in this report under the label "NSF Officials." Their opinions were very similar for the majority of questions. For a detailed breakdown of the group's responses, please refer to Appendix D. A description of the survey methodology, information on survey error, and the survey instrument are also in Appendix D.

Survey of Principal Investigators and Reviewers

This survey's sample frame was developed using three lists provided by NSF of (1) principal investigators who had received a decision on one or more NSF research proposals during calendar years 2009 and 2010, (2) individuals who had served as panel reviewers during 2009 or 2010, and (3) individuals who had served as ad-hoc reviewers during the same time period. Since individuals could be on more than one list and could appear more than once on the same list, all obvious duplicate entries were deleted. The final list of 100,509 individuals served as the sampling frame for the survey. A random sample of 8,000 individuals was invited to participate in the web survey. The questionnaire was developed and refined in consultation with NSF and NSB staff working with the NSB Task Force on Merit Review. The questionnaire was pretested with six individuals. Survey invitees received a presurvey email, an e-mail survey invitation, and two e-mail reminders from SRI. The presurvey email and the survey invitation included assurances that there would be no individual attribution to any survey respondent and that SRI as the survey administrator would maintain the confidentiality of all respondents. The survey remained open from March 22, 2011 to April 13, 2011. For analyses, respondents were categorized into one of 3 groups: 971 individuals who indicated they had only submitted a proposal to the NSF in the past two years (labeled "principal-investigator-only" in this report); 1,263 individuals who indicated they had only reviewed proposals for the NSF in the past two years (labeled "reviewer-only" in this report); and 1,755 individuals who had both submitted a proposal to the NSF and had reviewed proposals for the NSF in the past two years ((labeled "principal-investigator-and-reviewer" in this report). Overall response rate for the survey was 51%². There were 187 individuals who responded that they had neither submitted a proposal nor reviewed a proposal for NSF. A description of the survey methodology is provided along with the survey instrument in Appendix E.

Processes Used to Identify Themes

A substantial amount of qualitative and quantitative data on stakeholder views about the Merit Review criteria and Merit Review process were collected through the methods described above. SRI took steps to analyze and integrate these data with the goal of identifying and describing the substantive themes that emerged from stakeholder opinion. Qualitative data included written summaries of the interviews and written comments provided by survey respondents to open-ended survey questions, which were analyzed using a manual content analysis approach. Thousands of answers to interview questions and open-ended survey questions were compiled, coded, and grouped when similar in meaningful ways. The resulting tables are presented in Appendices B, C, D, and E. Quantitative data regarding views on and experiences with the Merit Review criteria and process were obtained through multiple-choice questions in the two web based surveys. These survey data were analyzed using standard descriptive and statistical techniques. Summary analyses are presented in Appendices D and E.

Through analysis of individual stakeholder responses and integration of emergent themes across stakeholder groups, six major themes emerged. While major aspects of these themes were supported by majority opinions within and across relevant stakeholder groups, some aspects of the themes are based on the views provided by substantial portions but not majorities of individuals within or across the stakeholder groups. Aspects of themes that were not based on majority support are identified as minority

² Due to imprecision in the initial sample information, reliable response rates for the three respondent subgroups of interest could not be calculated.

views. In addition, SRI paid special attention to areas of important differences between subgroups such as differences between the perceptions of respondents affiliated with NSF (including Program Officers, NSF Leadership, and Advisory Committee Members) and the perception of those representing the external community (principal investigators and reviewers).

Findings

This section provides a summary of stakeholder opinion obtained through interviews and surveys. The findings are organized by the six major themes that emerged.

Strengths and Weaknesses of the Intellectual Merit Criterion

Theme 1. The Intellectual Merit criterion is clearly defined and generally well understood, although there are some concerns related to the consideration of “transformative concepts” of proposed research and the level of emphasis placed on the qualification of the principal investigator.

Overall, the Intellectual Merit criterion is clearly defined and well understood.

There was a strong consensus across all stakeholder groups that NSF’s Intellectual Merit criterion guidance is clearly defined and the criterion is well understood. A large majority of the respondents to the *Survey of NSF Officials and Advisory Committee Members* rated the guidance published in the Grant Proposal Guide for the Intellectual Merit criterion as “excellent” or “good” for both principal investigators in formulating proposals and reviewers in assessing proposals, as displayed in Figure 1. The majority of respondents to the *Survey of Principal Investigators and Reviewers* also rated the guidance as “excellent” or “good”. As indicated in Figure 1, fewer principal-investigator respondents who have only submitted a proposal in the past two years rated the guidance as “excellent” or “good” as compared to the other respondent subgroups. One reason for this difference in opinion may be that more principal-investigator-only respondents indicated that it had been 15 or fewer years since their terminal degree than other subgroups. Fifty-seven percent (57%) of principal-investigator-only respondents indicated that it had been 15 years or less since their terminal degree compared to 43% of respondents who had submitted a proposal and had reviewed in the past 2 years. Another difference between the subgroups is experience as a reviewer. Many respondents wrote in the survey that serving as a reviewer was a very useful source of information on both criteria.³ Hence, experience as a reviewer may affect guidance rating positively.

While it was beyond the scope of the survey to assess the individual respondent’s own level of understanding of the use and application of the two Merit Review criteria, respondents were asked to offer their opinions about the overall level of understanding of each of the criterion in the principal investigator and reviewer communities. Majorities of the stakeholder groups rated the overall level of understanding of the Intellectual Merit criterion high. The *Survey of NSF Officials and Advisory Committee Members* found that majorities of the two stakeholder groups believe that members of both the principal investigator and reviewer communities have high levels of understanding of the Intellectual Merit criterion, as shown in Figure 2. Eighty-eight percent (88%) of NSF Officials felt that reviewers had a high or very high level of understanding of the Intellectual Merit criterion, and 81% felt likewise about principal investigators’ level of understanding. A somewhat smaller percentage, but still a majority, of Advisory Committee Member respondents felt principal investigators and reviewers had high or very high levels of understanding – 73% for each group.

³ See Appendix E for data.

As in the rating of guidance, fewer respondents in the principal-investigator-only subgroup agreed with the majority opinion of the other groups. In the *Survey of Principal Investigators and Reviewers*, 56% of principal-investigator-only respondents indicated that “all/almost all”, or “most” reviewers understood the Intellectual Merit criterion compared to 74% of principal investigators with experience serving as NSF reviewers in the past two years, as shown in Figure 3.

Individual answers from NSF Leadership interviews and university and college interviews support this theme that the Intellectual Merit criterion guidance is understood by most. In addition, respondents widely perceived that principal investigators understand how to address the intellectual merit of the proposal and reviewers can assess the intellectual merit. Respondents see the Intellectual Merit criterion as a major component of the peer review system, and say it sets the golden standard for excellence for NSF proposals. Comments included:

- “Everyone understands the Intellectual Merit criterion because it is a scientific and technical thing. People know how to identify creative ideas.”
- “There is common understanding about this criterion, partly because NSF has been doing this one for years. The community gets it; the reviewers get it.”

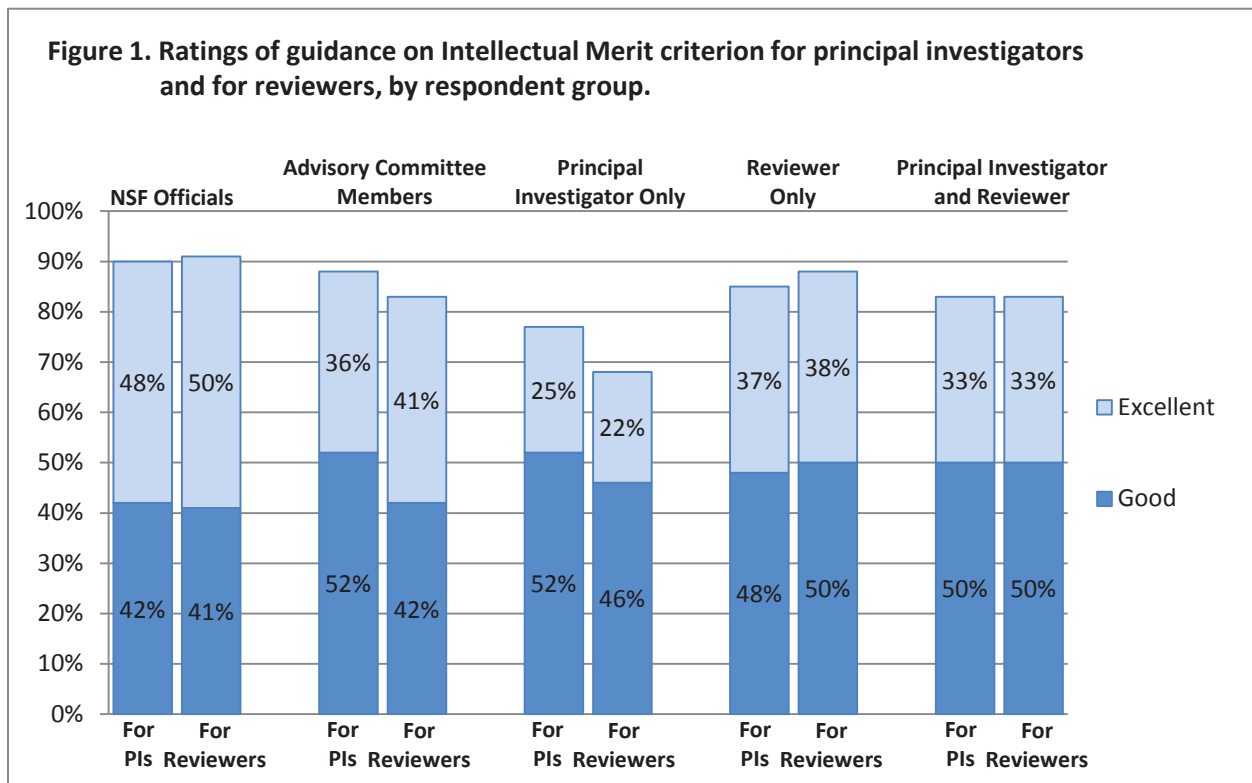


Figure 1. NOTE: NSF Officials – N(PI/Rev)=379/380; Advisory Committee Members – N(PI/Rev)=110/111; Principal Investigator Only – n(PI/Rev)=958/944; Reviewer Only – n(PI/Rev)=1237/1254; Principal Investigator and Reviewer – N(PI/Rev)=1747/1737. Question wording: In the Grant Proposal Guide, NSF provides the following list of potential considerations for the Intellectual Merit criterion: How would you rate this list as guidance for PIs in formulating proposals? For reviewers in assessing the proposals? Response scale: Very high level; High level; Moderate level; Low level; Very low level; No basis to judge. (All response categories used in percentage calculations.)

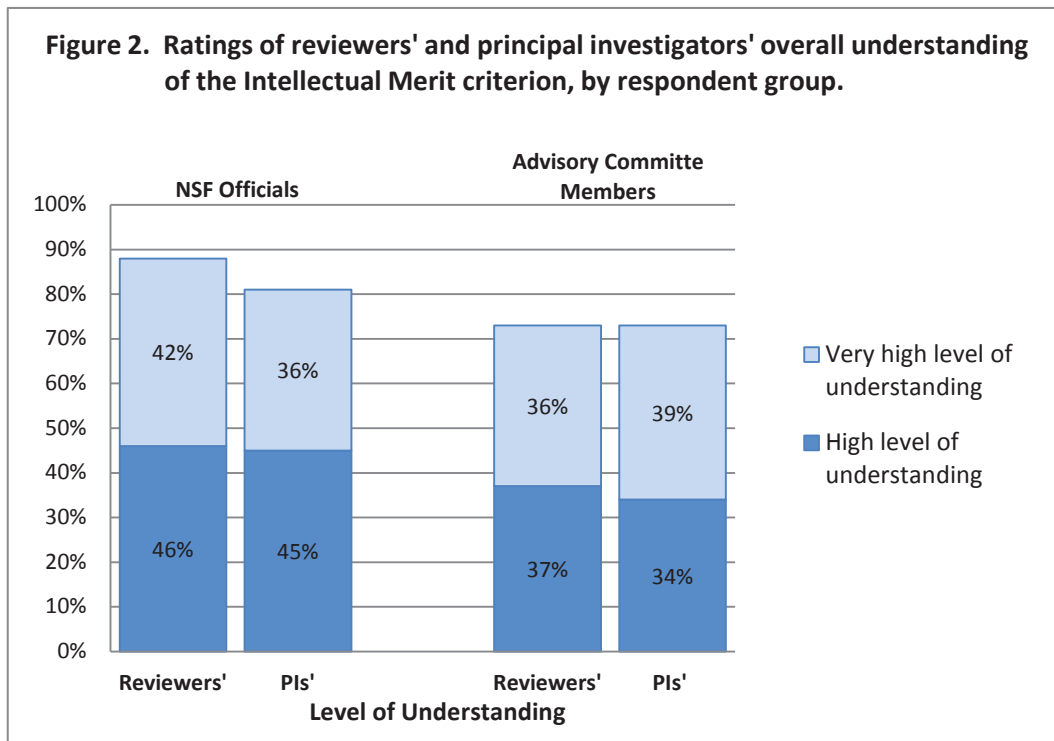


Figure 2. NOTE: NSF Officials – N(Rev/PI)=382/381; Advisory Committee Members – N(Rev/PI)= 111/109. Question wording: How would you rate the overall understanding of the Intellectual Merit and Broader Impacts criteria exhibited by members of the reviewer and the principal investigator (PI) community during the past 2 year period? Response scale: Very high level; High level; Moderate level; Low level; Very low level; No basis to judge. (All response categories used in percentage calculations.)

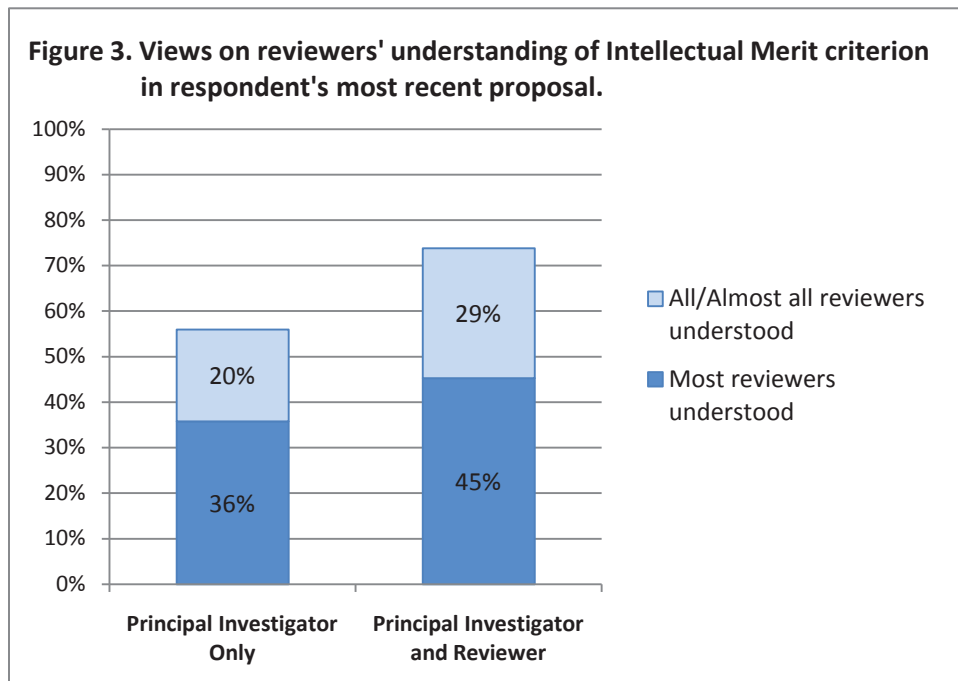


Figure 3. NOTE: n(IM)=2513. Question wording: Considering decisions you have received on NSF proposals during the past 2 to 3 years, what portion of those reviewers seem to have a sufficient understanding of each of the two Merit Review criteria? Response scale: All/almost all understood; Most understood; About half understood; Only some understood; Few/None understood; No basis to judge. (All response categories used in percentage calculations.)

There is a lack of consistent understanding and application of the consideration on potentially transformative concepts.

Though most stakeholders felt that the Intellectual Merit criterion is well understood, a significant number (though a minority percentage) of NSF Officials, NSF Advisory Committee Members, principal-investigator respondents, and reviewer respondents commented that the wording of the following consideration on potentially transformative research is vague and poorly understood: “To what extent does the proposed activity suggest and explore creative, original, or potentially transformative concepts?” Members of these stakeholder groups indicated that the guidance and/or definition of transformative concepts is unclear, which may result in inconsistent application of the criterion. Furthermore, some stakeholders felt strongly that the concept of transformative research is not appropriate on a philosophical ground, because research can be best understood as transformative only in retrospect after the outcome of the research is known. Therefore, they felt it is not appropriate to judge its value at the proposal stage. Others felt that overemphasis on transformative research may have a negative scientific impact if the reviewers ignore incremental research, which is essential for science even if it may not be potentially transformative.

The *Survey of Principal Investigators and Reviewers* asked respondents for suggestions on ways NSF could improve the guidance it provides to principal investigators and reviewers in the *Grant Proposal Guide* regarding the Intellectual Merit criterion. Sixty-eight responses requested that the NSF clarify the definition of transformative research because the current definition is vague and poorly understood. For example:

- “‘Transformative concepts’ is a poorly defined and vague term. If you ask 100 people what that means, you’ll get 100 different answers.”
- “I find that potentially transformative concepts [are] still poorly understood by panelists, reviewers, and principal investigators and should be better explained within the Intellectual Merit criterion.”
- “I’ve never liked the word transformative. It tends to become something people claim about their work without really knowing what it means. I know we are trying to avoid incremental research, but sometimes really important advances come out of work that may seem incremental. In research, one never knows. Perhaps challenging would be a better word. We don’t want people working on easy problems.”

This theme also emerged in the *Survey of NSF Officials and Advisory Committee Members*. Seventy respondents addressed the lack of clarity or inconsistent interpretation of transformative concepts. For example:

- “Creative, original and most of all, transformative are too nebulous for both principal investigators and reviewers. I think brevity should be forsaken here and either more descriptors of desired characteristics be given, or select some other terminology for these attributes.”
- “It is impossible to give a good definition of what is transformative, and certain groups of reviewers have latched onto the word as something to write on every proposal that they want funded. Many times I’ve seen reviews that said that the proposal was transformative without any statement about what, exactly, this transformation was.”
- “Advancing knowledge and understanding often times are incremental and evolutionary in the norm, more so than being abrupt and revolutionary. A weakness of the Intellectual Merit criterion

might be the illusion that proposed incremental and evolutionary advances, likely being deemed as not creative, not original and not transformative, are not acceptable or fundable by NSF.”

There is too much emphasis on the qualifications of principal investigators.

For the Intellectual Merit criterion, the potential consideration of “How well qualified is the proposer (individual or team) to conduct the project? (If appropriate, the reviewer will comment on the quality of prior work)” was also singled out by a substantial but minority of stakeholders as a potential consideration that also may be poorly understood and inconsistently applied. Stakeholders expressed concern that there is a tendency among reviewers to place too much emphasis on the principal investigator’s reputation as opposed to the ideas presented in the proposal, which may create a systematic disadvantage for new principal investigators and principal investigators from small institutions.

Web survey respondents’ written comments to open-ended questions addressed the issue of overemphasis on the principal investigator’s qualifications, including seventeen comments from the *Survey of NSF Officials and Advisory Committee Members*. A program officer said: “Reviewers sometimes use the Intellectual Merit guidelines as an excuse for rewarding principal investigators based only on name recognition. There should be more emphasis on the internal consistency and work plan of a project, independent of prior accomplishments. Sometimes principal investigators with strong track records achieve very high ratings on poorly presented or conceived projects.”

Forty-two comments from the *Survey of Principal Investigators and Reviewers* also raised similar concerns. For example:

- “In my opinion, the statement ‘How well qualified is the proposer to conduct the project...’ favors senior scientists with previous NSF grants. For an early career scientist is more difficult to receive an NSF grant since she/he cannot be judged on prior work.”
- “The problem I have with the reviewers trying to determine if the proposer is well qualified is that the disparities in institutions might lead a proposer to see a less equipped institution with a heavier teaching load as not qualified when in fact they have demonstrated that they can do the work because they have submitted preliminary data. Sometimes the reviewers own biases get in the way of seeing what a very determined person can do with what may look to them like puny resources. This tends to solidify the grant awards to those institutions in the highest tier of equipment or resources.”

Strengths and Weaknesses of the Broader Impacts Criterion

Theme 2. The Broader Impacts criterion goals are good; however, there is a lack of understanding of the criterion and calls for improved guidance.

The Broader Impacts criterion ensures the connection between scientific work and society.

Respondents to the *Survey of NSF Officials and Advisory Committee Members* were asked to identify the strengths of the Broader Impacts criterion. One hundred fifty-eight (158) comments reflected the theme that the Broader Impacts criterion ensures consideration of the connection between scientific work and society. For example:

- “The major strength of the [Broader Impacts] criterion is that it makes principal investigators and reviewers consider the implications of their work, both for related scientific bodies of knowledge and for society as a whole.”
- “This criterion forces applicants to consider how their project affects more than just themselves and their own research program and hopefully drives them to design their projects in such a way as to have a broader impact.”

In the interviews conducted with NSF Leadership and university and college representatives at nine institutions, there was also substantial agreement that the strength of the Broader Impacts criterion is that it compels the academic community to consider the connection between scientific work and society. NSF Leaders said:

- “The Broader Impacts [criterion] is wonderful in that it asks the question about what’s the context in which the Intellectual Merit takes place; how do we strengthen the value of research?”
- “By having to write about it, proposal writers now have to think about the societal context of their research beyond simple knowledge creation and beyond the ‘four walls of their lab’.”

The community-wide understanding of the Broader Impacts criterion is weaker than understanding of the Intellectual Merit criterion.

In both quantitative and qualitative questions, the majority of stakeholders’ responses reflected the theme of weaker understanding of the Broader Impacts criterion and its accompanying guidance. This is revealed in the stakeholders’ rating of the guidance given in the *Grant Proposal Guide*. As displayed in Figure 4, far fewer stakeholders rated the Broader Impacts criterion guidance as “excellent” or “good” than gave those same ratings for the Intellectual Merit criterion guidance (see Figure 1). Between 50% and 70% of each subgroup rated the Broader Impacts criterion guidance as “excellent” or “good”, which is much lower than the 70% to 90% range for the Intellectual Merit criterion guidance. Similar subgroup differences also appear in these ratings where the principal investigators who have only submitted a proposal in the past two years rated the guidance lower than the other subgroups.

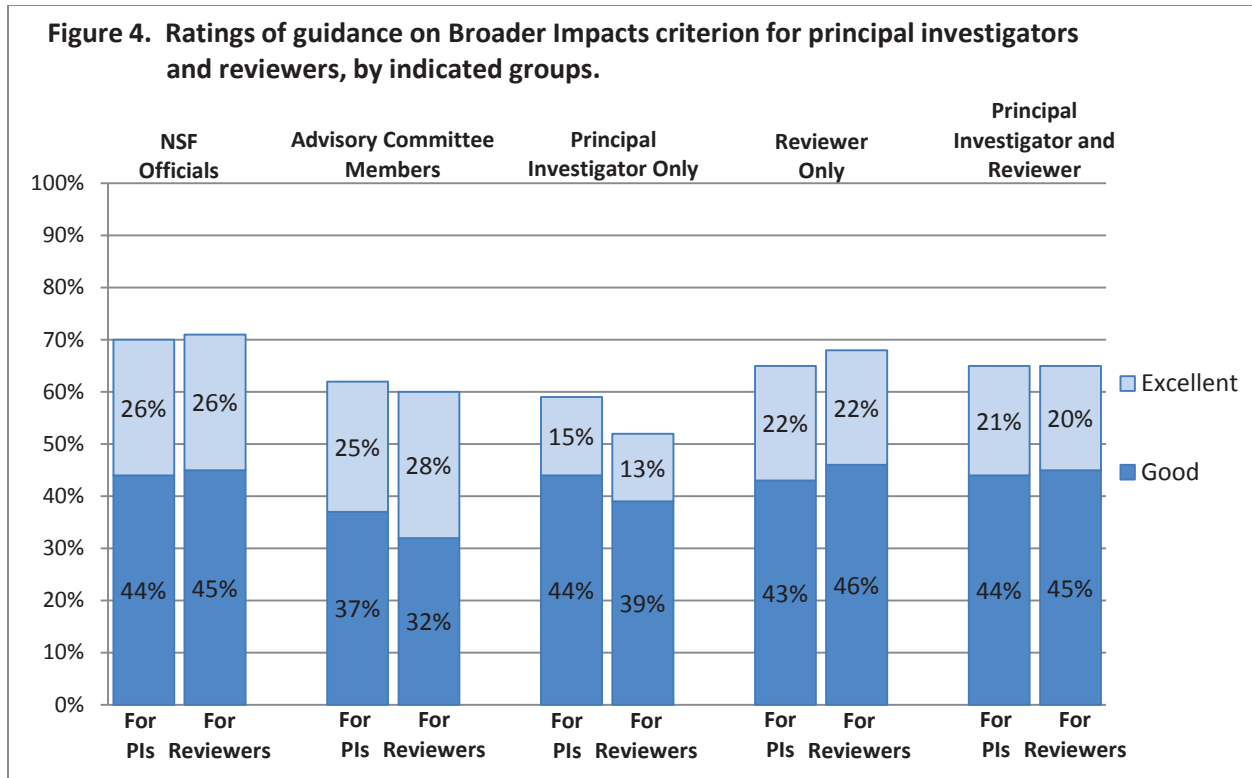


Figure 4. NSF Officials – N(PI/Rev)=379/380; Advisory Committee Members – N(PI/Rev)=110/111; Principal Investigator Only – n(PI/Rev)=958/942; Reviewer Only – n(PI/Rev)=1231/1247; Principal Investigator and Reviewer – n(PI/Rev)=1739/1728. Question wording: In the Grant Proposal Guide, NSF provides the following list of potential considerations for the Broader Impacts criterion: How would you rate this list as guidance for PIs in formulating proposals? For reviewers in assessing the proposals? Response scale –Very high level; High level; Moderate level; Low level; Very low level; No basis to judge (All response categories used in percentage calculations).

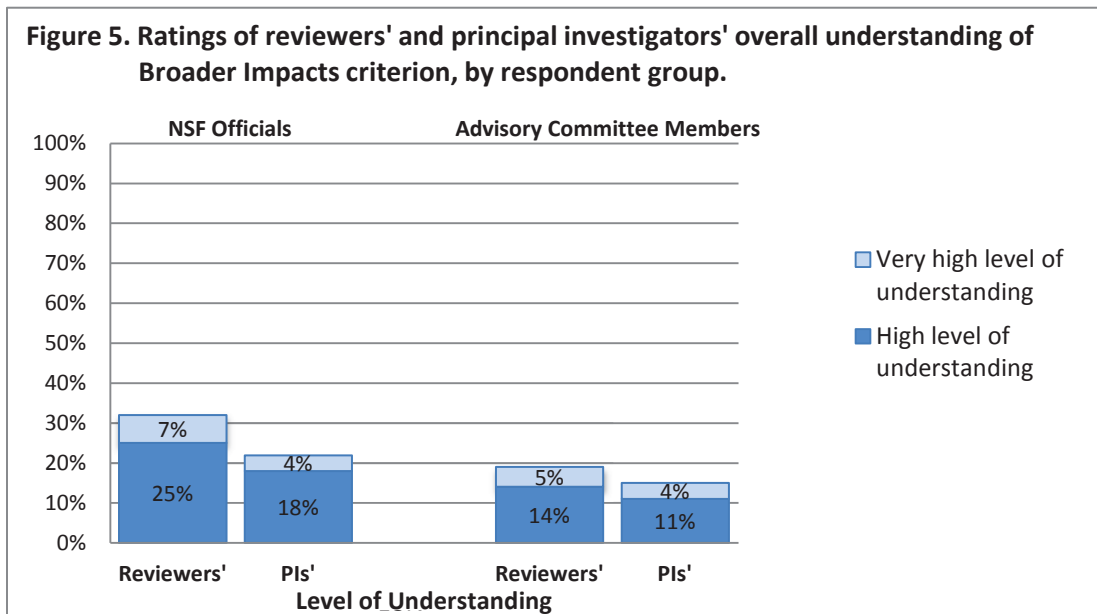


Figure 5. NSF Officials – N (Rev/PI)=382/381; Advisory Committee Members – N(Rev/PI)= 110/110. Questions wording: How would you rate the overall understanding of the Intellectual Merit and Broader Impacts criteria exhibited by members of the reviewer community during the past 2 year period? and How would you rate the overall understanding of the Intellectual Merit and Broader Impacts criteria exhibited by members of the PI community during the past 2 year period? Response scale: Very high level; High level; Moderate level; Low level; Very low level; No basis to judge (All response categories used in percentage calculations).

The decrease in ratings related to the Broader Impacts criterion also occurred in respondent ratings of users' understanding of the Broader Impacts criterion. This can be seen in the *Survey of NSF Officials and Advisory Committee Members* responses. Unlike the Intellectual Merit criterion where, as reported above in Figure 1, substantial majorities of respondents to the *Survey of NSF Officials and Advisory Committee Members* expressed the views that principal investigators and reviewers had a good understanding, this was a minority view with respect to the Broader Impacts criterion. As shown in Figure 5, only 32% of NSF Officials and 19% of NSF Advisory Committee Members felt that reviewers had a very high level or high level of understanding of the Broader Impacts criterion, and only 22% and 15% of Officials and Members respectively felt principal investigators had a very high level or high level of understanding.

The *Survey of Principal Investigators and Reviewers* also found a decrease in the ratings of principal investigator and reviewer understanding of the Broader Impacts criterion as compared with understanding of the Intellectual Merit criterion. As shown in Figure 6, 48% of the principal-investigator-only subgroup and 54% of respondents who had submitted a proposal and had reviewed felt that the majority of the reviewers of their most recent proposal understood the Broader Impacts criterion. Both ratings were lower than the ratings of the understanding of the Intellectual Merit criterion (Figure 3).

In addition to the lower quantitative guidance ratings, many stakeholders' comments elaborated on the lower rating of understanding of the Broader Impacts criterion. In 9 of the 12 interviews conducted with NSF Leadership, participants expressed the belief that principal investigators and reviewers struggle to find a common understanding of and evaluation metrics for the Broader Impacts criterion. As one NSF leader said: "The weakness of the Broader Impacts criterion is [that] it is mysterious to people; it is not understood by principal investigators, prospective principal investigators, or panelists. It is hard for reviewers to give the broader impacts a clearly objective set of evaluative criteria – how do you compare a proposal that includes grad students with one which partners with a museum? It varies from place to place and division to division."

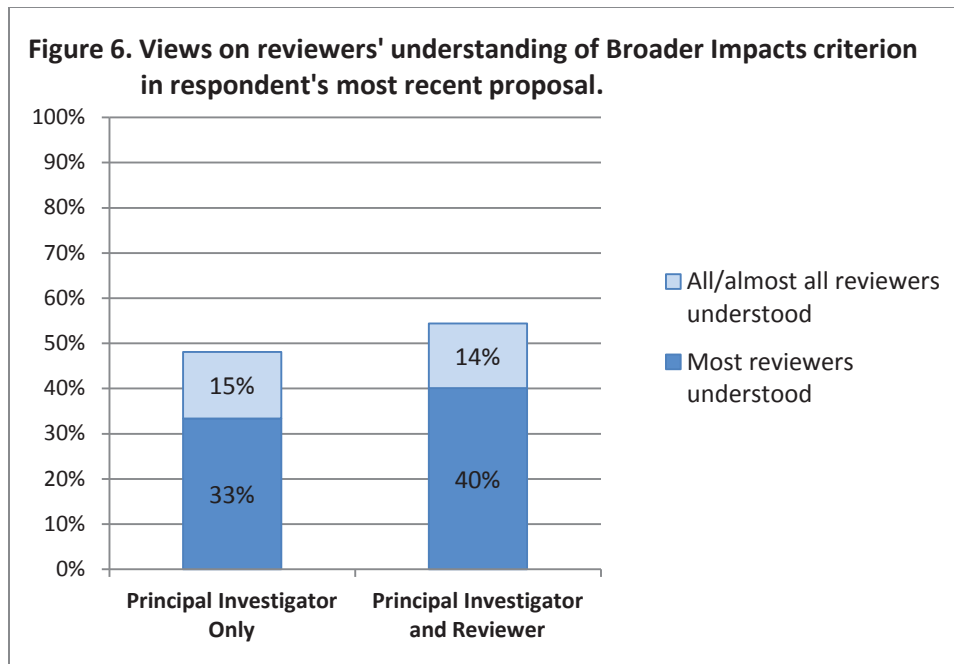


Figure 6. NOTE: n(BI)=2611. Question wording: Considering decisions you have received on NSF proposals during the past 2 to 3 years, what portion of those reviewers seem to have a sufficient understanding of each of the two Merit Review criteria? Response scale: All/almost all understood; Most understood; About half understood; Only some understood; Few/None understood; No basis to judge. (All response categories percentage calculations.)

Specific examples of the successful and less successful Broader Impacts activities are needed.

All stakeholder groups had a significant number of requests for NSF to provide examples of successful and less successful Broader Impacts activities as a suggestion to improve the guidance. In the *Survey of NSF Officials and Advisory Committee Members*, 72 comments offering suggestions to improve Broader Impacts criterion guidance asked for specific examples. One respondent wrote: “In providing guidance to principal investigators, it might be useful to give examples of projects that have made strong contributions in the Broader Impacts [goals].” In the *Survey of Principal Investigators and Reviewers*, 213 responses asked for specific examples of proposals with successful and less successful Broader Impacts statements. For example, one respondent wrote: “Provide examples of activities deemed meritorious, and those that are simply routine. The topic is far too broad and vague at present.”

Guidance on financial commitments for Broader Impacts activities is needed.

In addition to requests for specific examples of activities, stakeholders also petitioned for guidance on financial commitments for Broader Impacts activities:

- “People don’t have any guidelines for putting money [for Broader Impacts activities] in the budget. Putting in zero basically means it is an unfunded mandate to the institution. If there were guidelines that you should expect to spend roughly 5% of your budget on broader impacts then that would set a scale for the level of effort that is expected.”
- “The [Broader Impacts] guidance needs to be much more specific and should include discussion of how one might reasonably fulfill this requirement (independently, as part of a bigger effort? in collaboration with others?), whether or not the Broader Impacts has to be tied to the Intellectual

Merit, how much of the award's budget should go to the activity, whether or not the activity has to be novel?"

A lack of understanding of expected financial commitments was also suggested in the responses from principal investigators. Almost 90% percent of principal-investigator respondents reported that at least some of the Broader Impacts activities specified in their most recent NSF proposal went beyond activities associated with doing research and reporting results. However, only 56% of principal-investigator respondents said that they included in their most recent proposal budget costs associated with activities that they had identified as related to the Broader Impacts criterion.

The quantitative data that suggests budget confusion was supported by comments given in the *Survey of Principal Investigators and Reviewers* asking for budget guidance. For example, as two respondents wrote:

- “If Broader Impacts are going to be taken seriously, the principal investigator must request funds and time to support these activities. Half a page at the end of a proposal describing broader impacts with no obvious source of funding is not credible.”
- “It would certainly be helpful if an approximate percentage of the budget amount was provided in the Grant Proposal Guide since most research proposal principal investigators opt to minimize the actual dollar amount spent on Broader Impacts activities, often making it impossible to do Broader Impacts activities that are truly useful.”

Clarification is needed on the number and scope of the Broader Impacts activities that should be addressed in the proposal.

Stakeholders also expressed confusion about how many of the potential considerations included under the Broader Impacts criterion have to be addressed. When asked for suggestions to improve the guidance, 113 comments from the *Survey of NSF Officials and Advisory Committee Members* suggested that the Broader Impacts guidance be clarified to specify how many of the Broader Impacts considerations must be addressed. For example:

- “It likely would be helpful to highlight that while NSF expects at least one of the bullets to be considered in assessing Broader Impacts, in most cases there is not the expectation that the investigators take action in response to all of them.”
- “Make it clear that broader impacts do not have to include all these items but may stress one or several.”

This suggestion was also made in the *Survey of Principal Investigators and Reviewers* – 78 comments specifically requested that NSF clarify whether the potential considerations list for the Broader Impacts Criterion should be treated like a checklist. Comments included:

- “Guidance should make clear whether the items on the list should have 100% coverage or if a good proposal that does an excellent job of addressing one or two items on the list should be scored the same or higher than a proposal that treats it more like a grocery list.”
- “There's a concern that principal investigators feel that they must meet all criteria. This is not always possible. Principal investigators don't know how much weight will be given to each consideration in general and if the reviewers will give their own weight to a particular criterion. This is despite the statement that these are potential considerations.”

- “It is not clear whether each of these individual criteria must be met or if it sufficient to excel in several of them. The relative importance of each of these different points should be made clear.”

Comments from university and college representatives supported the theme that principal investigators and reviewers see all listed potential considerations for the Broader Impacts criterion as a checklist. Though respondents understood that NSF’s position is not to treat them as a checklist, they emphasized that the increasingly competitive funding environment compels principal investigators to address each and every potential considerations in their proposals. For example:

- “You’re afraid to omit something. It’s so competitive and there’s so many good proposals that you can’t afford to miss something. If you leave something out, one reviewer can cost you by saying ‘where is your activity on its value to society?’”
- “I think that the more competitive investigators are going to address each one of those items. If you don’t, you always leave yourself open to ‘you weren’t maximally responsive.’”
- “It’s one of the problems you get into as the funding climate becomes ever more competitive. Reviewers look for some ways to distinguish between very similar proposals. At that point, people just start going through and looking for things they can go back and ding proposals for. This is one way these review criteria can become kind of a check-off – [when reviewers] start marking down proposals because they don’t meet one of the bullet points.”

Simply clarifying the language to say that the principal investigator does not have to address all considerations may not be enough. It may be necessary to include a strong message for reviewers that the proposal should not be marked down for omission.

Weighting of Intellectual Merit Criterion and Broader Impacts Criterion

Theme 3. The Intellectual Merit criterion is and should be weighted more than the Broader Impacts criterion during proposal review, but guidance is lacking.

Stakeholders differed in their views of how the Intellectual Merit criterion should be weighted versus the Broader Impacts criterion during proposal review and decision. The web surveys found that NSF Officials, Advisory Committee Members, reviewers, and principal investigators all tended to believe that during the past several years the Intellectual Merit criterion has been weighted more than the Broader Impacts criterion in the review process. As shown in Figure 7, a majority of respondents in each of these stakeholder groups believed that Intellectual Merit received at least somewhat more weight than Broader Impacts by reviewers. In addition, when asked how much weight reviewers should place on Intellectual Merit versus Broader Impacts, a clear majority of respondents in each of these stakeholder groups felt that Intellectual Merit should have the greater weight.

However, there are some important differences across these groups as shown in Figure 7. First, higher percentages of the NSF Official (87%) and Advisory Committee Member (83%) respondent groups than the principal investigator (68%) and reviewer (55%) respondent groups were of the opinion that Intellectual Merit is being weighted more than Broader Impacts. Second, the NSF Official and Advisory Committee Member groups tended to want to see a decrease in the weight placed on Intellectual Merit. For example, 87% of the NSF Officials believed that Intellectual Merit is being weighted more than Broader Impacts but only 69% believed that it should be weighted more. In contrast, the reviewer and principal investigator groups tended to feel that Intellectual Merit should be weighted more than it currently is. As shown, 55% of the reviewer respondent group believed that Intellectual Merit is currently weighted more than Broader Impacts, but 76% believed that it should be weighed more. These differences suggest that there may be a disconnect between stakeholders who have responsibility for establishing policy (NSF Officials and Advisory Committee Members) and stakeholders who implement and respond to policy (reviewers and principal investigators).

Furthermore, there was also substantial opinion, though minority percentage, that the weighting should be dependent upon the contexts –14% of NSF Officials, 7% of Advisory Committee Members, and 3% of principal-investigators-and-reviewers respondents selected “Other – Please explain” when asked how much weight they think reviewers should place. The top written comments across all groups said that weighting should depend on a number of factors such as fields, types of programs, nature of the proposals, institutions, etc⁴. Some stakeholders voiced caution against setting an overly narrow or restrictive universal weight for each criterion. Some strongly believed that the weighting should allow flexibility and cautioned against providing clear guidance in exchange for flexibility. Striking a proper balance between clear guidance and flexible implementation is important. NSF, in providing clear guidance for weighting between two criteria, may want to take care to retain a level of flexibility.

In addition to the quantitative data, comments from stakeholders petition for specific weighting guidelines. In the *Survey of NSF Officials and Advisory Committee Members*, 19 individuals suggested

⁴ Please see Appendices E and D.

that there was a need for the relative weights of the Intellectual Merit and Broader Impacts to be clarified. For example, two said:

- “NSF should decide what it deems more important, state so clearly, and support accordingly. If [Intellectual Merit] and [Broader Impacts] are deemed equally important, not only should that be stated, but all directorates, divisions, and programs should adhere to the guidelines with consequences if they do not. If Intellectual Merit is deemed most important, then that should be stated unequivocally, rather than the accommodating language that is currently utilized. There is nothing wrong with stating that the substance of the research itself is paramount and everything else is secondary. That is the current, tacit understanding. Please make it clear or make [Broader Impacts] a true second criterion.”
- “In my opinion, it would be worthwhile for NSF to explicitly state their view of the relative importance of [Intellectual Merit] and [Broader Impacts] for standard research grants.”

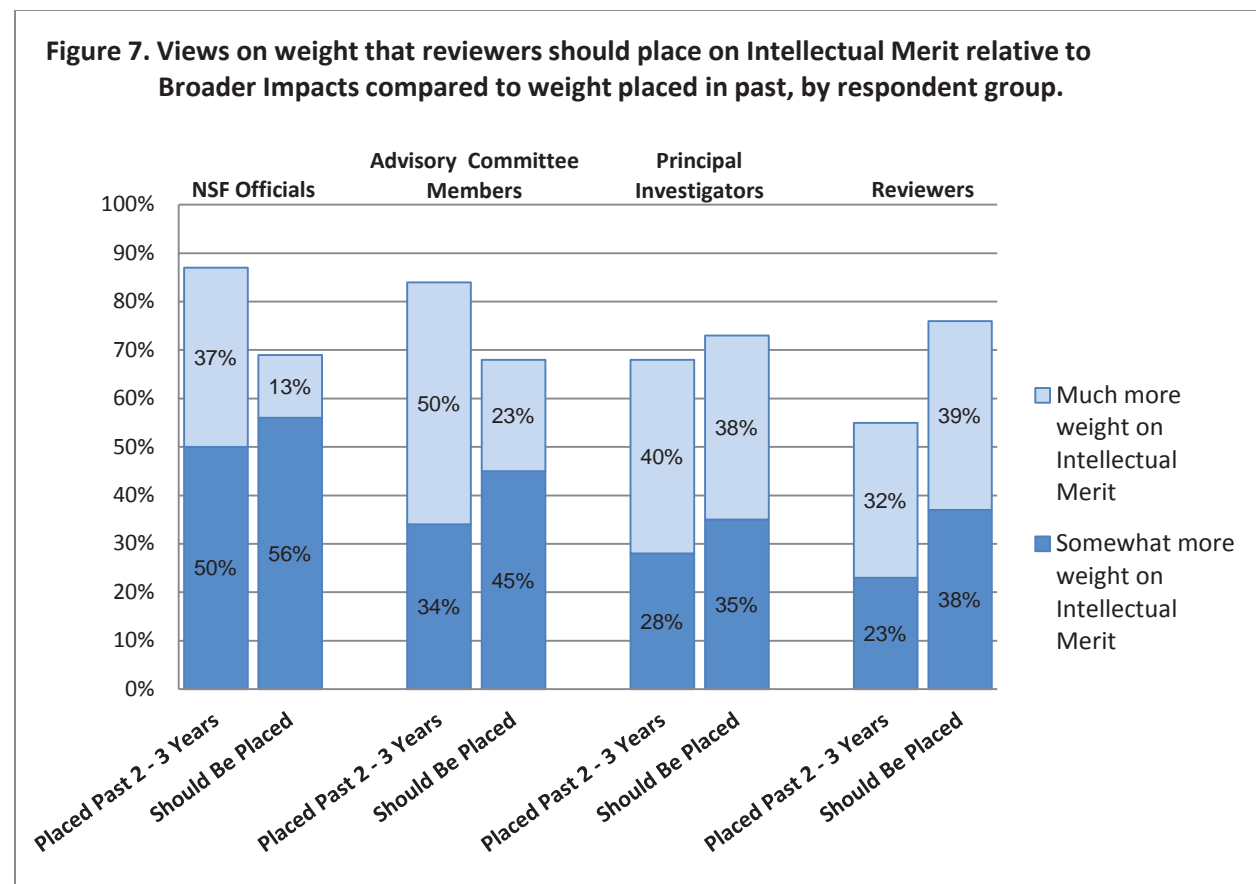


Figure 7. NOTE: NSF Officials – N(Past/Should)=(385/384); Advisory Committee Members – N(Past/Should) =111/111; Principal Investigators – n(Past/Should) = 2,714/2,710; Reviewers – n(Past/Should) = 2,,852/2,990. Question wording varied somewhat by respondent group. There is overlap between the principal investigator respondent group and the reviewer respondent group. Response scale: Much more weight on Intellectual Merit; More weight on Intellectual Merit; Somewhat more weight on Intellectual Merit; Both equally; Somewhat more weight on Broader Impacts; More weight on Broader Impacts; Much more weight on Broader Impacts. “More weight” and “Somewhat more weight” responses on the *Survey of NSF Officials and Advisory Committee Members* were combined to match the scale on the *Survey of Principal Investigators and Reviewers*. Please see survey instrument and data tables, found in the Appendices D and E.

Role of the Principal Investigator's Institution

Theme 4. Principal investigators' institutions should play a greater role in supporting Broader Impacts activities, and there are some steps NSF could take to encourage this.

Less than 40% of the respondents to both web surveys indicated that principal investigators' institutions should play a greater role in supporting the portion of principal investigators' proposals designed to satisfy the Intellectual Merit criterion (see Figure 8). However, opinions differed when groups were asked about a supporting role of institutions for Broader Impacts activities. Almost 70% of respondents to the *Survey of NSF Officials and the Advisory Committee Members* indicated that principal investigators' institutions should do "much more" or "somewhat more" to support Broader Impacts activities. Also, over half of the respondents to the *Survey of Principal Investigators and Reviewers* would like at least "somewhat more" (52%) institutional support for principal investigators' Broader Impacts activities⁵. In comments to open-ended questions, stakeholders' suggestions for ways institutions can be more supportive ranged from basic information sharing to institutional coordination and/or execution of Broader Impacts activities.

NSF Leaders also mentioned that they would like to see institutions develop support systems for Broader Impacts activities:

- "Colleges and universities can create a framework that allows principal investigators to hook into so that their burden is lessened. If each principal investigator has to think up afresh what to do and how to do it, I think its lost effort."
- "Institutions can create a central point on campus for thinking about Broader Impacts."

Interviews with representatives of nine universities and institutions revealed that some large institutions have institutional Broader Impacts programs for principal investigators to plug into, and that their sponsored research offices do try to facilitate those connections. However, the representatives of medium and small institutions interviewed reported that their institutions provide very little help (if any) in connecting principal investigators to Broader Impacts opportunities. Officials from the larger universities mentioned having large research centers that are supported by the NSF (such as the Materials Research Science and Engineering Center program) that allow institutions to play a more active role supporting Broader Impacts activities.

⁵ The subgroup respondents of the *Survey of Principal Investigators and Reviewers* had statistically identical opinions.

Figure 8. Views on whether principal investigator's institution should play a greater role in supporting the portion of principal investigator's proposals designed to satisfy the Merit Review criteria, by respondent group.

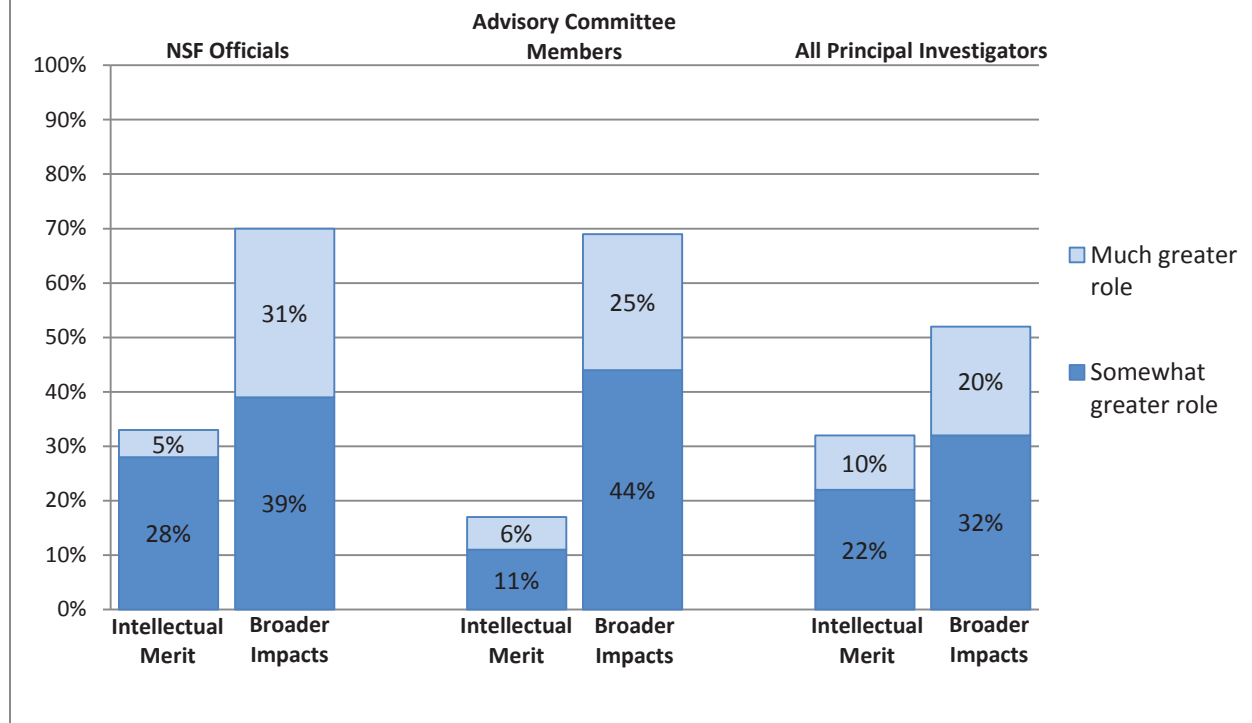


Figure 8. NOTE: NSF Officials – N(IM/BI) = 377/377; Advisory Committee Members – N(IM/BI) = 111/111; All Principal Investigators – n(IM/BI) = 2659/2638 (includes all respondents who had submitted a proposal in the past 2 years). Question wording: In your opinion, should PIs' institutions (your institution for PI survey) play a greater or lesser role in supporting the portion of PIs' proposals designed to satisfy the Intellectual Merit and Broader Impacts criteria? Response scale – Much greater; Somewhat greater; Stay the same; Somewhat less; Much less; No basis to judge. (All response categories were used in percentage calculations.)

What NSF can do to encourage institutional support.

The *Survey of NSF Officials and Advisory Committee Members* asked what steps NSF should take to increase the role principal investigators' institutions play in supporting the Broader Impacts of the proposals it funds. One hundred and twenty-four respondents suggested that NSF reward proposals that demonstrate institutional support through a letter or other documentation. For example:

- “Ask the institutions to show (through a support letter or something like that) commitments in supporting principal investigators to achieve their goals.”
- “Assurance by the Department Chair, Dean and/or Vice President for Research of ongoing activities within the institution that promote broader participation and steps they will initiate to support the principal investigator's efforts.”
- “Institutions should provide opportunities for new principal investigators to connect with existing broader impacts activities on their campuses, urge them to participate in these activities, and ensure that such participation adds value to those activities.”

In addition, 38 comments from the *Survey of NSF Officials and Advisory Committee Members* suggested that NSF help institutions identify and publicize existing programs and resources that are being used to support Broader Impacts activities. For example:

- “Emphasize that principal investigators can take advantage of existing programs – they need not invent new programs.”
- “Faculty who participate in appropriate institution-level programs should receive full credit for Broader Impacts, whether they are public information, technology transfer, or internship programs.”
- “Insist on describing how project fits in with existing broader impacts activities on campus.”

The *Survey of Principal Investigators and Reviewers* also asked for suggestions. Half of the 658 comments suggested that institutions consolidate Broader Impacts activities on campus through information dissemination, Broader Impacts offices, expert staff, and institution-wide programs. Comments included:

- “Most institutions have numerous projects and programs designed to broaden participation. However, many principal investigators are unaware of these. The institution can play an important role in connecting principal investigators to these projects/programs.”
- “It would be extremely helpful for me to know what programs already exist at my institution that satisfies Broader Impacts criteria, in which case I could decide which initiatives I am interested in joining and to which initiatives I could productively contribute.”
- “In my discussion with peers who have submitted NSF proposals, many of us struggle with the Broader Impacts statement because we don't have the relevant experience to address this section. The university could employ a professional with specific training in Broader Impacts statements to provide counsel to principal investigators with these statements.”

Post-award Assessment

Theme 5. Post-award assessment of the Broader Impacts activities of NSF-funded projects is weak and could be improved.

In regards to Intellectual Merit, the majority of stakeholders did not indicate a need for increased assessment. NSF Leaders were asked how much of a need, if any, exists to assess or document that funded proposals actually had Intellectual Merit. NSF Leaders said that, historically, NSF has depended on the checks and balances of the award cycle: if a principal investigator wants a new award, then they must provide evidence that they performed as expected under their past award(s). Leaders' comments included:

- “Projects currently have to submit annual reports. If the project is multi-year, [grants] can be cancelled [if there is a] lack of adequate performance.”
- “Another inherent check in the process is when an awardee comes back for another grant, it is looked at with regard to the principal investigator’s previous work. It’s self-evident that if a review panel sees that a principal investigator only did half of what he said he’d do, the new proposal will not be considered favorably.”

The lack of a need for new assessment mechanisms for Intellectual Merit was echoed in the web surveys. In the *Survey of NSF Officials and Advisory Committee Members* and in the *Survey of Principal Investigators and Reviewers*, respondents were asked if NSF should do more or less than it is currently doing to assess whether the goals of Intellectual Merit were realized in the completed research it funded. As shown in Figure 9, 45% of NSF Officials indicated that the NSF should do “somewhat more” (32%) or “much more” (13%) to assess attainment of Intellectual Merit goals. Thirty-eight percent (38%) of Advisory Committee Members and 33% of principal-investigator and/or reviewer respondents indicated “somewhat more” or “much more” to the same question.

Internal stakeholders and external stakeholders appear to hold different opinions about the need to increase post-award assessment of the Broader Impacts activities. More respondents to the *Survey of NSF Officials and Advisory Committee Members* would like to see NSF increase its assessment of Broader Impacts activities at least “somewhat” (62%). However, the percentage of principal-investigator and/or reviewer respondents did not increase – only 33% of these respondents would like to see assessment of Broader Impacts increase at least “somewhat”.

Ways for NSF to increase assessment

In the *Survey of NSF Officials and Advisory Committee Members*, respondents were asked to give suggestions for ways NSF could do more to assess whether or not the goals of the Intellectual Merit of the NSF funded research were realized. The most frequent themes recommended revising the reporting procedures. Many respondents suggested changing the annual report submission format to a format that is computer readable for ease of assessment. In addition, some respondents requested that NSF allow reporting for many years past the award termination date.

The survey also asked for suggestions on how to assess Broader Impacts— 72 responses suggested that the NSF should revise the annual/final reporting process to include an explicit Broader Impacts section.

Comments on Broader Impacts activities assessment included:

- “As a first step NSF should ask about outcomes and results from the Broader Impacts activities in the NSF annual and final report templates.”
- “Asking for specific evaluative information about Broader Impacts in the report templates would help.”
- “Principal investigators should be required to include more details of the Broader Impacts in their annual and final reports (i.e. student involvement). This could be accomplished by using a template that specifically asks for this information.”

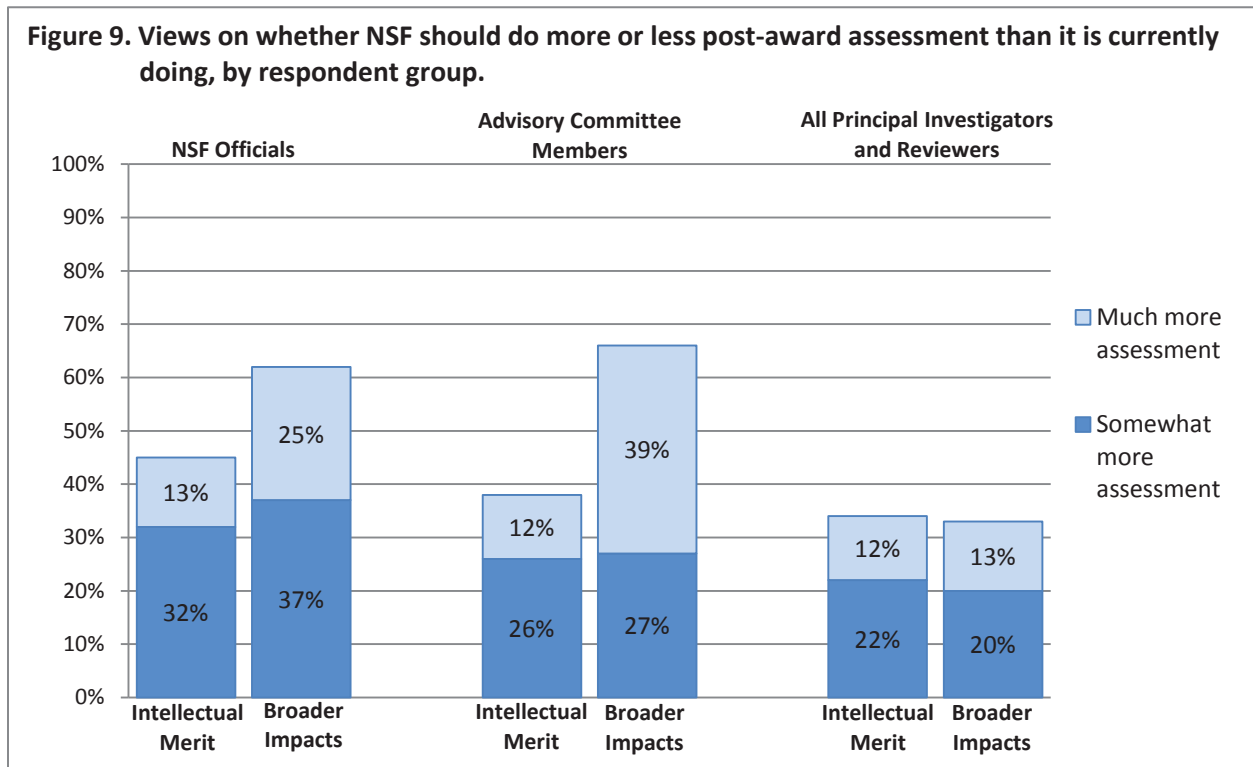


Figure 9. NOTE: NSF Officials – N(IM/BI) =382/382; Advisory Committee Members – N(IM/BI)= 111/111; Principal Investigators and Reviewers – n(IM/BI)= 3960/3953. Question wording: In your opinion, should NSF do more or less than it is currently doing to assess whether or not the goals of Intellectual Merit and Broader Impacts were realized in the completed research it funded? Response scale – Much more; Somewhat more; Stay the same; Somewhat less; Much less; No basis to judge. (All response scales included in percentage calculations.)

Impact of the Merit Review Criteria

Theme 6. The Merit Review criteria appear to have impacted how scientists think about their research.

NSF Leaders were asked if they felt the Merit Review criteria had any impact on how scientists think about their research. In six interviews, NSF leadership mentioned that they think that principal investigators have appeared to change how they think due to NSF requiring the Broader Impacts criterion to be addressed directly in the proposal. The change has required principal investigators to think seriously about the broader impacts of their work during proposal writing. One official said that program directors are seeing more society relevant projects than ever before.

Respondents to the *Survey of NSF Officials and Advisory Committee Members* also felt that the Broader Impacts criterion has impacted how scientists think about their research. In the survey, 158 responses reflected the theme that the Broader Impacts criterion has fostered awareness of the link between scientific work and society. For example:

- “A strength of this criterion is that it makes principal investigators think about their research from a perspective that they probably wouldn't otherwise include.”
- “I believe that in the 15+ years since verbalizing this criterion, many (by no means all) reviewers, panelists, program officers, etc have increasingly paid attention to Broader Impacts. When I first had to implement the 2 criteria as a program officer, 90%+ of the reviewers ignored it – the situation has certainly improved and people are more sensitive to this aspect of the support.”

Principal investigators were asked to evaluate their Broader Impacts activities of the past 2-3 years, and 35-40% of respondents indicated that most of their Broader Impacts activities went beyond those activities associated with doing the research and reporting results to other researchers⁶. The survey results suggest that the Merit Review criteria have impacted how scientists think about their research.

⁶ Question wording: What portion, if any, of the Broader Impacts activities specified in the most recent proposal you submitted to NSF went beyond those activities. Response scale – All or almost all; Most; About half; Some; None; No basis to judge. (All response categories included in percentage calculations.) N(Principal Investigator Only)=960; N(Principal Investigator and Reviewer)=1743.

Recommendations

Recommendation 1

NSF should provide clear definitions of the potential consideration phrases “transformative research” and “qualifications of the principal investigator”.

The vast majority of stakeholders rated highly the guidance for, and understanding of, the Intellectual Merit criterion. However, many individuals in interviews and in responses to open-ended questions expressed concern about confusion on the definition and application of “potentially transformative concepts” and “qualifications of the principal investigator”. Confusion may result in inconsistent application of the Merit Review criteria and/or systematic exclusion of some types of researchers.

Recommendation 2

NSF should include guidance on the types, the amount, and the level of effort expected for Broader Impacts activities.

Fewer stakeholders rated highly the guidance for, and understanding of, the Broader Impacts criterion. In responses to open-ended questions, the majority of responses requested more guidance on the level of effort expected for Broader Impacts activities. Across stakeholder groups, respondents requested more guidance on how many types of activities are expected and on the time and financial commitment expected for Broader Impacts activities.

Recommendation 3

NSF should provide better guidance about the use of the two criteria in the review process, including relative weight of each criterion.

Despite rule of thumb and informal guidance being offered by individual program officers, stakeholders are unclear as to how the two criteria should be weighted and have asked for clear and explicit guidance. If weighting is dependent upon proposals, programs, or institutions and flexibility is important (as some NSF Officials emphasized), NSF should provide guidance recognizing the importance of flexibility and context dependent variation of weighting.

Recommendation 4

NSF should enable and encourage institutional support for principal investigators’ Broader Impacts activities.

Almost 70% of NSF Officials and Advisory Committee Members and 50% of principal investigators and reviewers indicated that institutions should do at least “somewhat more” to “much more” to support their principal investigators’ Broader Impacts activities. Interviews and responses to open-ended questions supported these opinions by asking for mechanisms for institutions to aggregate

Broader Impacts activities in various means from simply publicizing existing programs for principal investigators to “plug into” to setting up Broader Impacts support offices complete with professional support staff. NSF should encourage aggregation activities that increase the efficiency of Broader Impacts activities, but not at the expense of principal investigator involvement.

Recommendation 5

NSF should improve assessment of Broader Impacts activities.

A majority of NSF Officials and Advisory Committee Members indicated that NSF should do more to assess outcomes of Broader Impacts activities included in the proposal. Specifically, some NSF Officials suggested revising annual report and final report templates to include outcomes and results from the Broader Impacts activities. However, principal investigators and reviewers are less enthusiastic about potentially increasing the reporting requirement.

Appendix A: Merit Review Criteria

NSF Merit Review criteria for Proposals

In your review, identify the proposal's strengths and weaknesses for each NSF Merit Review criterion:

- What is the intellectual merit of the proposed activity?
- What are the broader impacts of the proposed activity?

Below are potential considerations for each criterion. These are only suggestions for evaluation, and not all will apply to any given proposal.

What is the intellectual merit of the proposed activity?

- How important is the proposed activity to advancing knowledge and understanding within its own field or across different fields?
- How well qualified is the proposer (individual or team) to conduct the project? (If appropriate, the reviewer will comment on the quality of prior work.)
- To what extent does the proposed activity suggest and explore creative, original, or potentially transformative concepts?
- How well conceived and organized is the proposed activity?
- Is there sufficient access to resources?

What are the broader impacts of the proposed activity?

- How well does the activity advance discovery and understanding while promoting teaching, training, and learning?
- How well does the proposed activity broaden the participation of underrepresented groups (such as gender, ethnicity, disability, geographic, etc.)?
- To what extent will it enhance the infrastructure for research and education, such as facilities, instrumentation, networks, and partnerships?
- Will the results be disseminated broadly to enhance scientific and technological understanding?
- What may be the benefits of the proposed activity to society?

Source: United States. National Science Foundation (2001, October 1). *Grant Proposal Guide, January 2011*. Retrieved July 19, 2011 from the National Science Foundation website:

http://nsf.gov/publications/pub_summ.jsp?ods_key=gpg

Appendix B: Summary Report of Interviews with NSF Leadership

Introduction

All National Science Foundation (NSF) proposals, as part of the Merit Review process, are evaluated with respect to two Merit Review criteria—Intellectual Merit and Broader Impacts. The two-criteria system was instituted in 1997, replacing a four-criteria system in place since 1981. In the *Grant Proposal Guide* (GPG), NSF provides a list of potential considerations for merit review for the criteria. Two major revisions to the Merit Review criteria have occurred since they were implemented in 1997. Prior to 2001, principal investigators (PIs) were encouraged to address the broader impacts of their proposed work; however, since 2001, NSF has required that proposals include a specific statement on Broader Impacts activities. Proposals lacking such a statement are returned as incomplete. In 2007, potentially transformative was added to the Intellectual Merit criterion potential consideration as follows: To what extent does the proposed activity suggest and explore creative, original, or potentially transformative concepts?

Methodology

Officials in leadership positions in NSF Directorates and Offices were interviewed in November 2010 to gather information on their views and experience with the use and utility of the Merit Review criteria. Twelve in-person interviews were conducted with a total of 22 people. Their names and titles are listed in Appendix B1. Interview questions covered the current use of the Merit Review criteria, the advantages and disadvantages of the criteria, the effects of the Merit Review criteria, institutional and NSF roles in implementing the Criteria, and changes the interviewees would recommend. The Interview Guide is listed in Appendix B2.

Two SRI representatives conducted each interview. One SRI representative facilitated the interview while the other took notes on the participant's responses. A written summary of each interview was prepared based on the notes taken. The interviews were conducted in a conversational style with SRI directing the conversation to cover all the topics in the interview guide. SRI made sure each topic was covered, but all "probes, as needed" questions were not asked of every interviewee. If the interviewee(s) had covered a particular topic while responding to a previous question, the topic was not asked about again. Also, interviewee(s) did not always have an opinion on every topic covered in the interview. Please note that in this section, illustrative comments are paraphrased.

SRI staff performed a content analysis of the interview summaries to identify recurring themes in interview responses. The themes identified spanned multiple topics addressed in the interview guide. The following summary is organized by the recurring themes identified in the content analysis, not by the topics listed in the interview guide. A recurring theme is one that emerged in at least three of the interviews conducted.

Disclaimer

The interviews were confidential, and no particular quote or statement should be attributed to an individual person or office. This report is a synthesis of themes that emerged during the interviews and is intended as an information source for the Task Force on Merit Review.

Summary of Interviews

The table below shows the recurring themes that emerged during content analysis of NSF Leadership interviews. A synopsis of each theme follows the table. A crosswalk between these themes and the interview guide topics is contained in Appendix B3.

Recurring Themes	Interview Frequency*
The Broader Impacts criterion is supported by NSF leadership.	12
Intellectual Merit criterion is well understood by principal investigators and reviewers.	11
Broader Impacts criterion and/or expectations are not clear.	9
Some principal investigators' institutions have increased their institutional support for Broader Impacts activities, while other institutions should do more.	7
There are some processes in place to do post award assessments that focus mainly on Intellectual Merit, but many post-award assessments, especially in the area of Broader Impacts, are extremely difficult.	7
NSF could do more to support Broader Impacts Activities.	6
The Broader Impacts criterion appears to have changed the way researchers think about their research.	6
There are ways the Broader Impacts criterion could be clarified.	5
Reviewers have difficulty evaluating and/or weighting Broader Impacts criterion potential considerations.	4
Reviewers and principal investigators place more weight on the Intellectual Merit criterion than on the Broader Impacts criterion.	4
One Intellectual Merit criterion potential consideration: "How well qualified is the proposer (individual or team) to conduct the project?" is given too much weight by reviewers.	3

*12 total interviews were conducted, some of which included more than one interviewee. This is a count of the number of *interviews* in which an official said something on the indicated theme.

Strengths and Weaknesses of the Intellectual Merit Criterion

The NSF Leadership felt that the Intellectual Merit criterion was well understood; however, some leaders stated a need for clarification in criterion implementation.

Intellectual Merit criterion is well understood by principal investigators and reviewers.

During all but one interview sessions, NSF Leadership said that the strength of the Intellectual Merit criterion was that it is well understood by principal investigators and reviewers:

- Everyone understands the Intellectual Merit criterion because it is a scientific and technical thing. People know how to identify creative ideas.
- Simply stated, review committees understand this criterion.
- [Intellectual Merit is the] easiest thing to get your head around.
- There is common understanding about this criterion, partly because NSF has been doing this one for years. The community gets it; the reviewers get it.

One Intellectual Merit criterion potential consideration: “How well qualified is the proposer (individual or team) to conduct the project?” is given too much weight by reviewers.

In spite of the predominant view that Intellectual Merit was well understood, in three interviews, leaders raised a concern with some reviewers’ implementation of the Intellectual Merit criteria consideration of *How well qualified is the proposer (individual or team) to conduct the project? (If appropriate, the reviewer will comment on the quality of prior work.* Leaders raising this concern felt that this consideration is given too much weight in panel discussions. Leaders’ statements included:

- One weakness of the Intellectual Merit criterion is that some panelists try to evaluate the principal investigator(s) based on their reputation rather than the strength of the proposal. Some reviewers think – “We should fund the stars first”.
- There is a fine line between (1) they have set out everything and it looks like they can do it and (2) they can do it because of who is doing it. The “trust me” proposal is more likely to get funded.

Strengths and Weaknesses of the Broader Impacts Criterion

All leaders praised the spirit of the Broader Impacts criterion; however, all had suggestions for improvements related to clarification of the published text on the Broader Impacts criterion and in the implementation of the Broader Impacts criterion.

The Broader Impacts criterion is supported by NSF Leadership.

During every interview, leaders praised the concept of Broader Impacts. Some leaders pointed out that they are handing out taxpayer money; therefore, projects should be framed in the context of the “greater good”. Leaders said things such as:

- The strength of having Broader Impacts as a criterion is that it shows that NSF cares about something beyond the “Intellectual Merit”.

- The Broader Impacts criterion calls researchers' attention to the role of their work in society.
- The Broader Impacts [criterion] is wonderful in that it asks the question about what's the context in which the Intellectual Merit takes place, how do we strengthen the value of research?

The Broader Impacts criterion and/or expectations are not clear.

In nine interviews, leaders expressed the concern that the Broader Impacts criterion is vague, and that proposers and reviewers struggle to find a common understanding or evaluation metric. Leaders' statements included:

- The Broader Impacts criterion is interpreted very differently by the different communities. There is a higher bar in some communities than in others. If your research will affect other sciences, that's a broader impact in some communities. Often panelists don't pick up on the fact that this is a new principal investigator or a member of an underrepresented minority. Panelists don't understand that *that* is a part of Broader Impacts.
- The weakness of the Broader Impacts criterion is that it is mysterious to people; it is not understood by principal investigators, perspective principal investigators, or panelists.
- The criteria for deciding what is a good broader impact were never well defined – everyone has struggled with it. It is like a big fuzzy ball.
- [The vagueness of the Broader Impacts criterion] causes confusion because the community thinks that specific things need to be described for the criterion; reviewers and some program officers also think that.
- There is a general misconception it has only to do with education or of getting more women/minorities into STEM (Science, Technology, Engineering, and Mathematics) fields.
- Broader Impacts are seen as a “moving target” – there is frustration among principal investigators that they have to develop a Broader Impacts plan and they don't know how best to do that.

In three interviews where leaders raised concerns about the clarity of the Broader Impacts criterion guidance, leaders suggested that the lack of clarity can result in proposers viewing the potential considerations for the Broader Impacts criterion as a checklist. Their statements included:

- People get confused in that the areas for Broader Impacts are like a shopping list. Principal investigators wonder if they have to address all [potential considerations] on the list or just one or just some. Young faculty especially sees it as a checklist.
- If you look at the bullets [potential considerations] under the criteria, you see that they cover a wide range of topics. What happens is that principal investigators and sometimes program officers don't really know whether or not it is important to address all the bullets.
- There are many different ways to get broader impacts. There is some feeling in parts of the community that different pieces of Broader Impacts are more important than others, that you are supposed to deal with all of it, and if you don't deal with all considerations at a higher level, you're not doing the job.

There are ways the Broader Impacts criterion could be clarified.

In five interviews, officials made some suggestions for improving the Broader Impacts criterion, most related to clarifications and instructions, such as:

- Add “consistent with the scope of your project.”
- Add examples specific to a program.

- Add “improve international collaboration”.
- Carefully articulate what NSF means by “Broader Impacts”, and perhaps state some flexibility as to how much some awardees are expected to respond vs. other awardees.
- Give the Broader Impacts criterion a better umbrella definition so that people understand that the potential considerations are just examples.

Weighting of Intellectual Merit Criterion and Broader Impacts Criterion

Reviewers have difficulty evaluating and/or weighting Broader Impacts criterion potential considerations.

In four interviews, NSF Leaders indicated that while reviewers are typically well qualified to evaluate the Intellectual Merit criterion, they are not consistently able to effectively evaluate the Broader Impacts criterion. The leaders suggested that reviewers have a very hard time comparing different types of Broader Impacts, saying things such as:

- Reviewers are frustrated that they don’t have the expertise to compare working with a high school class vs. developing a museum exhibit vs. working with an HBCU [Historical Black Colleges and Universities]. They can only look at whether it seems reasonable.
- It is hard for reviewers to give the Broader Impacts criterion a clearly objective set of evaluative criteria – how do you compare a proposal that includes graduate students with one that includes a partnership with a museum?

Reviewers and principal investigators place more weight on the Intellectual Merit criterion than on the Broader Impacts criterion.

Also in four of the interviews, leaders mentioned that they see reviewers and proposers weight the Intellectual Merit criterion more heavily than the Broader Impacts criterion, making statements such as:

- Broader Impacts statements are sometimes seen as a “tie-breaker” or as a way to pick one proposal over the other.
- Leaders hear: “If we are going to fund something it has to have intellectual merit; then we look at the broader impacts.”
- People have problems weighting the two criteria. They have heard that the weighting is often 80/20, Intellectual Merit to Broader Impacts. There is no rule about this but Intellectual Merit is the driving force for most reviewers –where this is a strength or a weakness depends on the proposal.
- The default with many proposals is that they describe research and then add a little paragraph that has to do with their graduate students, or they will talk a bit about what they plan to do with respect to outreach. The main issue has to do with the lack of understanding by the people who write proposals, the reviewers, and also the staff at NSF. There is not a very sophisticated understanding of what a broader impact can be. You get a cookie cutter approach – principal investigators just throw a piece in.

Principal Investigator's Institution's Role

Some principal investigators' institutions have increased their institutional support for Broader Impacts activities, while other institutions should do more.

In five interviews, officials reported that some principal investigator's institutions have taken steps to support principal investigators' Broader Impacts activities. Examples include:

- Some sponsored research offices really know how to do this [support proposers], others not so much, which makes for an unequal playing field. Good offices may actually write the proposals and that may not be a bad thing. They also may find the solicitation and find someone who can do the work. This is not necessarily a bad thing because the sponsored research office also makes sure that the work gets done. The sponsored research office knows what's in the NSF guide and is essentially doing NSF's work. Universities that get a lot of grant money have very strong sponsored research offices. This can make it an uneven playing field for principal investigators who are not at these universities with strong sponsored research offices.
- The role of the university's grant office is to make sure people know about the various opportunities, and advise on the format. Intellectual Merit and Broader Impacts are part of the content, which is the principal investigator's responsibility. But the institution can help principal investigators understand what NSF means by "Intellectual Merit" and "Broader Impacts".
- Some [institutions] have established outreach offices that have been used pretty heavily since the Broader Impacts criterion was introduced. They can provide the linkages that would be difficult for a principal investigator to do on their own.
- Some universities have a center that works with principal investigators on how to design a good broader impacts aspect of a proposal. They provide expertise to the principal investigators.

In seven interviews, leaders mentioned that they would like to see support systems for Broader Impacts activities spread to other universities, saying things such as:

- Colleges and universities can create a framework that allows for principal investigators to hook into so that their burden is lessened. If each principal investigator has to think up afresh what to do and how to do it, that is wasted effort.
- Institutions can create a central point on campus for thinking about Broader Impacts.

Role of NSF

NSF could do more to support Broader Impacts activities.

In six interviews, leaders offered suggestions for NSF's role in enhancing the Broader Impacts of funded research:

- NSF could expose principal investigators to innovative and creative ways to have a broader impact.
- NSF could provide a "dating service" to help with the connections – to help form partnerships between institutions that are genuine partnerships.
- NSF could support a prize for an institution that is doing this really well to demonstrate that NSF is stepping out and emphasizing Broader Impacts.

- NSF could expand the Broader Impacts criterion potential considerations to include economic development.
- NSF could partner with private philanthropy groups.

Post-award Assessment

There are some processes in place to do post-award assessments that focus mainly on Intellectual Merit, but many post-award assessments, especially in the area of Broader Impacts, are difficult.

In all interviews, leaders reported that there is a push across the agency to improve post-award assessment. Some offices have dedicated people for this task. Historically, many leaders say NSF has depended on the checks and balances of the award cycle: if principal investigators want a new award, then they must have evidence that they excelled under their past award(s). Other methods mentioned by leaders included:

- Projects currently have to submit annual reports. If the project is multi-year, contracts can be cancelled because of a lack of adequate performance.
- Results from previous awards are required to be put in subsequent proposals, so we look at that.
- Another inherent check in the process is when an awardee comes back for another grant; the proposal is looked at with regard to the principal investigator's previous work. It's self-evident that if a review panel sees that a principal investigator only did half of what he said he'd do, the new proposal will not be considered favorably.
- Grants are actually made to the university. Universities are audited. There is some trust that universities and departments are making sure people are doing what they say they will do.
- The STAR METRICS [Science and Technology for America's Reinvestment: Measuring the Effect of Research on Innovation, Competitiveness and Science] is evaluating the information technology required for in-depth evaluation of such things as annual reports.

In three interviews, officials identified some of the difficulties associated with post-award assessment. These leaders see both Broader Impacts and Intellectual Merit as very hard to evaluate after the award period:

- We are better able to evaluate Intellectual Merit than Broader Impacts. For many programs, just looking at how many minorities graduated is not a broader impact because it is at the core of the program. Broader Impacts may not be measurable over the lifespan of the project. For example – the impact of the development of a widely applicable model may only be seen over a long time span.
- You can count Broader Impacts activities, but there is a quality measurement problem. Also a timing problem, how do you measure Broader Impacts that happen beyond the award period?
- With Intellectual Merit, it is hard to evaluate a project if it does not work. It is hard to make nonscientists understand that something not working is just as important as something working.

Impact of the Merit Review Criteria

Broader Impacts criterion has appeared to have changed the way researchers think about their research.

In six interviews, leaders expressed the belief that requiring the Broader Impacts criterion to be addressed directly in the proposal has changed the way proposers think about doing their research. Leaders' comments included:

- Program directors are seeing more society-relevant projects than ever before.
- Proposals now fund more graduate students, instead of just science, which promotes the training mission of the Broader Impacts criterion.
- By having to write about it, proposal writers now have to think about the societal context of their research beyond simple knowledge creation and beyond the “four walls of their lab”.
- Proposers and reviewers, especially those in an early career stage, no longer question leaders on the need for Broader Impacts statements, implying that “broader impacts” has become ingrained in the NSF-supported research culture.

Appendix B1: Interview Participants

The following NSF staff participated in the meetings:

- Joann Roskoski, Directorate for Biological Sciences
- Peter Arzberger and Suzi Iacono, Directorate for Computer & Information Science & Engineering
- Myron Gutmann and Judy Sunley, Directorate for Social, Behavioral & Economic Sciences
- Tom Peterson and Michael Reischman, Directorate for Engineering
- Tim Killeen and Marge Cavanaugh, Directorate for Geosciences
- Barbara Olds and Linda Slakey, Directorate for Education & Human Resources
- Machi Dilworth, Directorate for Mathematical & Physical Sciences
- Susan Winter, Office of Cyberinfrastructure
- Larry Weber and Mark Suskin, Office of International Science and Engineering
- W. Lance Haworth and Kathryn Sullivan, Office of Integrated Activities
- Lawrence Rudolph, Office of the General Counsel
- Martha Rubenstein and Joanna Rom, Office of Budget, Finance, and Award Management

The discussions were facilitated by Jongwon Park or Tom Slomba and recorded by Lori Thurgood or Purdy Brown of SRI, International.

Appendix B2: NSF Leadership Interview Guide

Note: This document is designed to be used as guide for interviews conducted with NSF Leadership. It is not intended to be used as a structured interview. Topics will not necessarily be addressed in the order presented below. Interviewers will probe and follow-up as needed. The purpose of this guide is to help ensure that a series of similar topics are addressed in all interviews.

Introduction – Introduce SRI Representatives and provide purpose of study.

Purpose of Study

Thank you for agreeing to be interviewed as part of our effort to obtain the views and experiences of NSF Leadership related to the utility of the Merit Review criteria and review Process for the NSB Task Force. As indicated in the e-mail you received from Joanne Tornow requesting your participation, following our interviews with NSF Leadership, we will also be obtaining input from other stakeholder groups including representatives of universities/colleges and university associations, NSF Program/Division Directors, current members of the 14 NSF Advisory Committees, Principal Investigators, and Reviewers.

If you do not object, we would like to record our interview with you. The information you provide during the course of this interview will not be attributed to you personally in our report. Any attribution would be made in a generic form such as “A current NSF official suggested...” or “A university representative reported that...”

Do we have your permission to record the interview?

Do you have any questions before we begin?

Topic 1 – Respondent Role/ Responsibilities Related to Merit criteria and Review

Before I start with the topics we’ll be discussing, could you provide a brief description of your roles and responsibilities related to the Merit Review Process and the Review criteria and your overall perspective on Merit Review.

Topic 2. Strengths and Weaknesses of criteria and Process

Let’s start our discussion with your overall views on the strengths and weaknesses of the current criteria and what you think about the way the review process works in applying the two criteria.

Probes as needed:

- What do you see as the strengths of the criterion of intellectual merit?
- What do you see as the strengths of the criterion of broader impacts?
- What do you see as the weaknesses of the criterion of intellectual merit?
- What do you see as the weaknesses of the criterion of broader impacts?

- What about the way the review process works for assessing intellectual merit? What are the strengths and weaknesses of that process?
- What about the way the review process works for assessing broader impacts? What are the strengths and weaknesses of that process?
- To what extent, if at all, have the applications of each of the 2 Merit Review criteria evolved over time?

As necessary, review history of criteria:

NSF's Intellectual Merit and Broader Impacts criteria were put in place in 1997. In 2001 the requirement that proposers and reviewers must address both criteria was initiated. Then in 2007 the Intellectual Merit Review criterion was modified to specifically include the extent to which a proposal also suggests and explores potentially transformative concepts.

Topic 3. Selection of Reviewers

Next, I'd like to get your opinion on the selection of reviewers and what part that plays for each of the merit review criterion.

Probes as needed:

- Overall, how well equipped are reviewers to assess intellectual merit?
- Overall, how well equipped are reviewers to assess broader impacts?
- What changes, if any, are needed in reviewer selection to ensure that the review processes effectively address Intellectual Merit and Broader Impacts?

Topic 4. Institutions' Role in addressing Merit Review criteria

Our next topic is – What are the roles of the PIs' institutions in addressing the merit review criteria?

Probes as needed:

- What is the role of the PI's institution in assuring the intellectual merit of the proposal?
- What is the role of the PI's institution in assuring that broader impacts are addressed in the proposal?
- What more, if anything could PIs' institutions do to help ensure that the intellectual merit described in a proposal is realized?
- What more, if anything could PI's institutions do to help ensure the broader impacts identified in a proposal are realized?

Topic 5. NSF's Role in Enhancing the Broader Impacts of Funded Research

Next I would like to explore your views on what additional roles, if any, NSF itself might play in enhancing the Broader Impacts of the research it funds?

Probe as needed:

- For example, are there any changes in the grant review process that could enhance activities such as data sharing, data archiving, or other collaborative activities?

Topic 6. Merit criteria's impacts on how scientists think about doing their research

With some modifications, the 2 Merit criteria have been used since 1997. I would be interested in your views on the extent to which, if at all, the use of the 2 criteria have changed the way scientists think about doing their research.

Probe as needed:

- What changes, if any, resulted from the 2001 requirement that both Intellectual Merit and Broader Impacts must be addressed in a proposal?
- What changes, if any, resulted from the 2007 modification in the Intellectual Merit criterion to specifically include the extent to which a proposal also suggests and explores potentially transformative concepts?

As necessary, review history of criteria:

NSF's Intellectual Merit and Broader Impacts criteria were put in place in 1997. In 2001 the requirement that proposers and reviewers must address both criteria was initiated. Then in 2007 the Intellectual Merit Review criterion was modified to specifically include the extent to which a proposal also suggests and explores potentially transformative concepts.

Topic 7. Intellectual Merit and Broader Impacts criteria considerations

Next I would like to get your views on some of the guidance NSF provides regarding the 2 Merit criteria. I have a list for you that shows NSF's five considerations for each of the criterion. These are included in the Proposal and Award Procedures Guide and are provided to Reviewers in Proposal Review Instructions. They are intended to be suggestions and may not apply to any given proposal.

Probes as needed:

- What are your views, if any, on how these Intellectual Merit considerations are used by reviewers and proposers?
- What, if anything, could be done to improve the considerations that are offered related to Intellectual Merit?
- What are your views, if any, on how the Broader Impacts considerations are used by reviewers and proposers?
- What, if anything could be done to improve the considerations that are offered related to Broader Impacts?

Background as need:

From -- NSF 10-1 January 2010 Chapter III - NSF Proposal Processing and Review - The criteria include considerations that help define them. These considerations are suggestions, and not all will apply to any given proposal. While proposers must address both merit review criteria, reviewers will be asked to address only those considerations that are relevant to the proposal being considered and for which the reviewer is qualified to make judgments.

Topic 8. Assessments of Intellectual Merit and Broader Impacts of Funded Proposals

Next I would like to discuss what happens as a result of the review process. The overall goal of the process is to ensure that the proposals funded have Intellectual Merit and will have Broader Impacts. In your view, how much of a need, if any, is there to assess or document that funded proposals actually had Intellectual Merit and/or Broader Impacts?

Probes as needed:

- Who has primary responsibility for assessing or documenting the Intellectual Merit of funded proposals?
- Who has primary responsibility for assessing or documenting the Broader Impacts of funded proposals?

Topic 9. Changes in the criteria or review process

We have discussed a number of topics related to the criteria and the Review Process. What changes, if any, would you like to see made to the Merit criteria and/or the review process in the near future?

Topic 10. Input from PIs and Reviewers

As I mentioned when we started, we will be obtaining input from PIs and Reviewers as part of our study. We intend to do this through a web-based survey. Are there any specific questions regarding the Merit criteria and/or the Review Process you would like to see us include in our survey?

Topic 11. Other Comments/Concerns

I have no other specific questions. Do you have any other comments or concerns about the Intellectual Merit and Broader Impacts and/or the Merit Review Process?

Appendix B3: Crosswalk between Themes and Interview Guide.

Recurring Themes	Interview Guide Topic
Intellectual Merit criterion is well understood by principal investigators and reviewers.	Topic 2/Topic 7
One Intellectual Merit criterion potential consideration: “How well qualified is the proposer (individual or team) to conduct the project?” is given too much weight by reviewers.	Topic 2/Topic 3/Topic 7
The Broader Impacts criterion is supported by NSF leadership.	Topic 2
There are ways the Broader Impacts criterion could be clarified.	Topic 2/Topic 7
Broader Impacts criterion and/or expectations are not clear.	Topic 2/Topic 3/Topic 7
Reviewers have difficulty evaluating and/or weighting Broader Impacts criterion potential considerations.	Topic 3/Topic 7
Reviewers and principal investigators place more weight on the Intellectual Merit criterion than on the Broader Impacts criterion	Topic 3/Topic 7
Some principal investigators’ institutions have increased their institutional support for Broader Impacts activities, while other institutions should do more.	Topic 4
NSF could do more to support Broader Impacts activities.	Topic 5
There are some processes in place to do post-award assessments that focus mainly on Intellectual Merit, but many post-award assessments, especially in the area of Broader Impacts, are extremely difficult	Topic 8
The Broader Impacts criterion has appeared to change the way researchers think about their research.	Topic 6

Appendix C: Summary Report of Interviews with University and College Officials

Introduction

All National Science Foundation (NSF) proposals, as part of the Merit Review process, are evaluated with respect to two Merit Review criteria – Intellectual Merit and Broader Impacts. The two-criteria system was instituted in 1997, replacing a four-criteria system in place since 1981. In the *Grant Proposal Guide* (GPG), NSF provides a list of potential considerations for merit review for the criteria. Two major revisions to the Merit Review criteria have occurred since they were implemented in 1997. Prior to 2001, principal investigators (PIs) were encouraged to address the Broader Impacts of their proposed work; however, since 2001, NSF has required that proposals include a specific statement on Broader Impacts activities. Proposals lacking such a statement are returned as incomplete. In 2007, potentially transformative was added to the Intellectual Merit criterion potential considerations as follows: “To what extent does the proposed activity suggest and explore creative, original, or potentially transformative concepts?”

Methodology

Officials at nine different universities were interviewed either in-person or over the phone during January and February 2011 to gather their opinions on the Merit Review criteria and to inform the design of future large-scale surveys. Representatives from institutional offices that are in charge of sponsored research activities were interviewed. Participating institutions are listed in Appendix C1. Four institutions are large Ph.D.-granting research institutions. The remaining five institutions are of a small to medium size, ranging from a community college to institutions that award only undergraduate and master degrees. Questions covered the current use of the Merit Review criteria, the advantages and disadvantages of the criteria, the Merit Review criteria effects, and changes the interviewees would recommend. The interview sample was much smaller than any statistically significant sample of university and college representatives would be. Therefore, statements made by these nine university and college representatives should be taken as illustrative and not representative of all university and college representatives. The Interview Guide is listed in Appendix C2.

Two SRI representatives conducted each interview. One SRI representative facilitated the interview while the other took notes on the participant’s responses. A written summary of each interview was prepared based on the notes taken. The interviews were conducted in a conversational style with SRI directing the conversation to cover all the topics in the interview guide. SRI made sure each topic was covered, but all “probes, as needed” questions were not asked of every interviewee. If the interviewee(s) had covered a particular topic while responding to a previous question, the topic was not asked about again. Also, interviewee(s) did not always have an opinion on every topic covered in the interview.

SRI staff performed a content analysis of the interview summaries to identify recurring themes in interview responses. The themes identified spanned multiple topics addressed in the interview guide. The following summary is organized by the recurring themes identified in the content analysis, not by the

topics listed in the interview guide. A recurring theme is one that emerged in at least three of the interviews conducted.

Disclaimer

The interviews were confidential, and no particular quote or statement should be attributed to an individual person or institution. This report is a synthesis of themes that emerged during the interviews and is intended as an information source for the Task Force on Merit Review criteria.

Summary of Interviews

Table 1. Frequency of common themes from interviews with university and college representatives

The table below shows the recurring themes of comments made by nine university and college representatives during the interviews. A synopsis of each theme follows the table. A crosswalk between these themes and the interview guide topics is contained in Appendix C3.

Recurring Themes	Frequency (of 9)
All representatives say the Broader Impacts criterion is good, but confusing.	9
All representatives see more weight being placed on Intellectual Merit over Broader Impacts.	9
All representatives have concerns about any new assessment requirements.	9
Intellectual merit is well understood by principal investigators and reviewers.	7
All representatives support the <i>America COMPETES Reauthorization Act</i> language, but many of them expressed concerns over implementation.	7
Representatives feel current methods of Intellectual Merit assessment are adequate.	7
Most representatives say the Broader Impacts criterion has changed how people think about the scientific process.	7
Most representatives see a need to aggregate Broader Impacts activities at institution and/or NSF level.	6
Some representatives request more clarity on certain Intellectual Merit potential considerations.	5
Officials have concerns over reviewers' ability to assess Broader Impacts statements.	5
Some representatives see the potential considerations under the Merit Review criteria as a "check list."	5
Smaller Institutions want more guidelines and examples.	4

Strengths and Weaknesses of the Intellectual Merit Criterion

Intellectual merit is well understood by principal investigators and reviewers.

The major strength of the Intellectual Merit criterion was cited by representatives to be the fact that most people understand it well. This theme was echoed by every institution, with representatives saying things such as:

- “Intellectual Merit is time tested; people understand it better.”
- “Most scientific review panels and proposers would understand these criteria [and] agree that Intellectual Merit [criterion considerations] are the right ones to apply”
- “The Intellectual Merit criterion is a perfectly good fit for individual research grants.”
- “Technical merit is something that we all as experts understand well.”

Some representatives request more clarity on certain Intellectual Merit criterion potential considerations.

No universally recognized weakness to the Intellectual Merit criterion emerged; however, about half of the representatives mentioned at least one potential consideration under the criterion that they felt was unclear. Three representatives mentioned confusion with the potential considerations of “To what extent does the proposed activity suggest and explore creative, original, or potentially transformative concepts?” saying:

- “Transformative concepts [are] hard to know – there is a lot of work that [is] absolutely essential for science to move forward that may not be transformational, but is required for transformational research.”
- “Not everyone sees what is transformative in the same way. I think that we have to be clearer about what that is.”
- “We’re a master’s level, comprehensive university. We have a lot of good research activity going on but we don’t have the huge amount of infrastructure that a Research I does. When NSF looks for transformational projects, it automatically involves huge research infrastructure [which excludes our institution].”

The potential consideration of “How well qualified is the proposer (individual or team) to conduct the project?” was also mentioned as a weakness by two representatives, with one saying, “How do new investigators get in on the action? Prior work is a good criterion for those who have prior work – but it would be nice for a note that encourages new investigators.”

Two representatives from smaller institutions shared struggles with the application of Intellectual Merit criterion to proposals that are different from the simple research grant:

- “[Intellectual Merit criterion] starts to get stretched when you talk about grants for scholarships or student training programs. What I would ask is whether or not this particular criterion is as good of a fit for some of the other programs that NSF funds.”
- “When you have a proposal that is designed for scholarship students, we might have different views of how to interpret Intellectual Merit.”

All the requested changes to the Intellectual Merit criterion centered on the theme of clarity, as suggested in the quotes above.

Strengths and Weaknesses of the Broader Impacts Criterion

All representatives say the Broader Impacts criterion is good, but confusing.

Every single representative praised the spirit of the Broader Impacts criterion; however, every official also said that the Broader Impacts criterion is confusing – both in scope and implementation. For example:

- “I think [the criteria] have worked out really well, especially for Broader Impacts: it allows the researchers an opportunity to extend their boundaries. I think it has done a really nice job for bringing in especially K-12 efforts, with the schools and other institutions. It has brought in a lot of diversity.”
- “There is a lot of confusion about what is expected from proposers because it is hard to know what level...of effort the NSF and reviewers expect the principal investigator to put in.”
- “[Broader Impacts] are more opaque...If applications are made clear, then at least that can help.”

Many representatives requested clearer Broader Impacts guidelines, saying things such as:

- “People don’t have any guidelines for putting money in the budget [for Broader Impacts activities]. Putting in zero basically means it is an unfunded mandate to the institution. If there were guidelines that you should expect to spend roughly 5% of your budget on Broader Impacts then that would set a scale for the level of effort that is expected.”
- “I think examples or sub-lists of what Broader Impacts could be are in some ways helpful.”
- “It would be helpful to provide outstanding samples and subcomponents so that everyone would be responding to the same information.”

Representatives have concerns over reviewers’ ability to assess Broader Impacts statements.

The vast majority of institution representatives felt that reviewer selection results in panels and ad hoc reviewers that are experts in the technical subject, and that are well qualified to judge Intellectual Merit. However, many representatives voiced concern over reviewer’s ability to judge Broader Impacts. A few representatives voiced concern that some reviewers may have some biases and inconsistencies that are expressed in their comments. In addition, representatives would like to see reviewers receive more training in general:

- “Reviewers know what the science is – I’m not sure they can assess Broader Impacts. They need guidelines, FAQs, scenarios.”
- “Training of the reviewers, as far as what is expected of them, what they are seeking to achieve, will provide more uniformity in the way things are reviewed.”
- “NSF could better educate the reviewers... [to avoid] types of comments that are not substantially related to the research.”
- “I guess that taking the bias out would be important. We had a reviewer comment, ‘this university doesn’t do research so this can’t be a very good proposal,’ which obviously didn’t get received very well.”

Representatives at smaller institutions, where teaching loads may be higher, voiced a desire for a review system that does not involve as large a travel and time commitment as the current panel system does. As

one said: “I want more people from our institution because I think it is a wonderful learning opportunity. But to be honest, if you are working at an institution such as ours, we have a very heavy teaching load. So then, what can be done to enable people to meet their job expectations, but also to participate in these types of activities?”

More than half of representatives noted difficulty in having scientists judge Broader Impacts activities, for example:

- “Some people on the panel might be able to assess [Broader Impacts statements], but we really need someone with a much broader vision and an ability to think beyond their own discipline to truly assess the value of Broader Impacts statements in a proposal.”
- “‘Broader Impacts’ is a very broad term. We have some confusion among the researchers on what exactly they mean.”

Criteria Guidance

Smaller institutions want more guidelines and examples.

Institution type influenced the representatives’ comments. Representatives from large institutions’ sponsored research offices said they deal with large volumes of proposals, and rarely saw reviewer comments on declined proposals. In small and medium institutions, the proposal volume is much lower, and their staff stated that they are much more involved in the details of the proposals – from making sure criteria are addressed before submission to going over reviewer comments of all declined proposals. The comments from interviewees from smaller institutions were more focused on the specific details of the Merit Review criteria. These representatives expressed a need for more structure and more examples so that they could be, as one official said, “maximally responsive.” These representatives want very clear, very structured guidelines, saying things such as:

- “The more specific the funder could be about exactly what they expect, then the more responsive the principal investigators can be.”
- “[The criteria] give everyone the same starting block; everyone knows they have to address these; and it gives some commonality for the reader and preparer.”
- On the topic of the potential considerations under the criteria, two representatives specifically requested weights for the guidelines, as one official said, “[It would be] good to get some guidance in how strongly [one thing] would be weighted in comparison to some of the other things. It is not always clear to investigators.”
- “I would like...examples [that] indicate that [the considerations] aren’t meant to be exhaustive, but are meant to be examples.”

Declinations seemed to resonate more heavily at smaller institutions, and the review process seemed more opaque to them, as illustrated by representatives at these small institutions not knowing how reviewers are chosen: “I don’t know a lot about reviewer selections. A lot of our faculty didn’t know they can be an NSF reviewer – there was an NSF workshop where they mentioned that people could become new reviewers. A lot of (especially new) faculty had questions about this and weren’t aware it was an option.”

Half see potential considerations as a “check list”

Representatives at all types of institutions felt that proposals should address all the potential considerations under each criterion. Five out of the nine universities had a representative say that they see all potential considerations as a “check-list”. The view that all potential considerations should be addressed manifested itself in many comments, such as:

- “You’re afraid to omit something. It’s so competitive and there’s so many good proposals that you can’t afford to miss something. If you leave something out, one reviewer can cost you by saying ‘where is your activity on its value to society?’”
- “Most proposers don’t want to miss out on any one.”
- “I think that the more competitive investigators are going to address each one of those items. If you don’t, you always leave yourself open to ‘you weren’t maximally responsive’”.
- “Faculty try to address the Broader Impacts criterion to the best they can, but it is not clear what they are going to be evaluated on, what things are going to resonate with reviewers, or what they are going to be able to do.”
- “It’s one of the problems you get into as the funding climate becomes ever more competitive. Reviewers look for some ways to distinguish between very similar proposals. At that point, people just start going through and looking for things they can go back and ding proposals for. This is one way these review criteria can become kind of a check-off – [when reviewers] start marking down proposals because they doesn’t meet one of the bullet points.”
- “The successful ones do [see the criteria as a check list]. They feel they have to hit [every potential consideration].”

One suggestion for change: combine Intellectual Merit and Broader Impacts considerations.

About half of the representatives mentioned that they see an overlap between the Broader Impacts criterion and the Intellectual Merit criterion. One official explicitly suggested combining the Intellectual Merit and Broader Impacts criteria, and representatives from small institutions and minority-serving institutions say that their Broader Impacts are woven into their Intellectual Merit by virtue of their environments:

- “I think the only way to change [Broader Impacts being viewed as an afterthought] is to seamlessly connect the two criteria, so that you don’t have to write the proposal based on [the] science...and then say, I really should now think about Broader Impacts. But you are actually doing that as you write.”
- “Being a 2-yr college, Broader Impacts [criterion] almost fits better sometimes than Intellectual Merit [criterion] does. We want to get students of all descents, and we want to get more people to consider careers in STEM fields. That’s really more what we do than some of the Intellectual Merit.”
- “From my perspective at a small liberal arts college model – the Broader Impacts side turns out to be pretty important in making my case in why the NSF should support my research. My proposals typically focus on the Intellectual Merit to the greater extent, but also have substantive Broader Impacts sections, which talk about things such as students who have done research in my group – where they end up – it often leads them to graduate school or medical school or some other science-related field.”

- “We do a lot of training of students who go on to get their doctorates, and we have more student involvement in undergraduate level research programs. Having research grants that are able to employ students and get them involved in projects is an important part of the educational process.”

Two representatives pointed out that transformative research is a Broader Impact if it succeeds:

- “Research itself as transformative is a broader impact. If you do something big, it is a Broader Impact.”
- “Difficulty comes in ‘Broader Impacts’ seeming very vague. ‘Advancing discovery’ refers to the Intellectual Merit criterion as a way of Broader Impacts, so it kinds of confounds those individual measures.”

Weighting of Intellectual Merit criterion and Broader Impacts criterion

All representatives see more weight being placed on Intellectual Merit over Broader Impacts.

At every size institutions, representatives indicated that they felt that both on the proposal writing side and the proposal reviewing side, the Intellectual Merit is viewed as the most important part of the proposal and Broader Impacts play a minor role. Representatives said things such as:

- “[If] a proposal is really compelling in its Intellectual Merits it will still be at the top of the funding heap even if something is missing in diversity.”
- “If you look at a typical proposal, you probably won’t pass the reviewer test if you don’t deal with the Intellectual Merit well. If you don’t have the Intellectual Merit well worked out, you won’t be funded. A typical principal investigator in a standard research proposal probably won’t devote a lot of his or her resources to Broader Impacts efforts because it will take away from what [they think] will get them funding in the reviewers’ minds.”
- “Honestly, I feel like they [principal investigators and reviewers] think of those things [Broader Impacts] as an afterthought rather than something to build their proposal around.”
- “[There is a] fair amount of cynicism in saying you write something for the Broader Impacts and hope that the reviewers, who don’t really know what they are looking for either, somehow will believe it.”
- “Because it goes out into many different areas, and it’s more diverse, typically proposal writers don’t devote much time in building that case. It seems less significant than Intellectual Merit, particularly for straight research proposals.”

Institutional Roles

Institutional support varies.

Interviews revealed that large institutions have some institutional Broader Impacts programs for principal investigators to “plug into,” and that their sponsored research offices do try to facilitate those connections. However, the medium and small institutions say they provide very little help (if any) connecting principal investigators to large Broader Impacts opportunities. Representatives from large universities mentioned

having large research centers that are supported by the NSF (such as the Material Research Science and Engineering Centers (MRSEC) program) and have large Broader Impacts programs. Small and medium-sized institutions did not mention any of these big centers.

Most representatives see a need to aggregate Broader Impacts activities at institution and/or NSF level.

More than three-quarters of the representatives suggested that the current method of tacking on a small Broader Impacts activity to every proposal results in less being done than could be done. As one representative said, “It is very hard to have a real impact if you have something a mile wide and a millimeter deep.” This sentiment was reflected in a common theme that emerged from representatives’ comments: Broader Impacts efforts might be more effective if aggregated – either through principal investigators plugging into a bigger Broader Impacts program or by NSF funding specific Broader Impacts efforts:

- “If we want Broader Impacts to really impact society, we need to build towards some bigger effort.”
- One official pointed to the large research centers, such as the MRSECs as a “best practice”, where the programs and funding are aggregated to a “scale that they can have a quasi-professional who knows how to do [Broader Impacts] right.”
- “It would be nice if there was some encouragement of Broader Impacts [activities] where people feed into the other activities at the university or schools so that we start to build a web of linked activities that add to or augment existing efforts.”
- “NSF could try to figure out mechanisms for aggregating [Broader Impacts] – getting more ‘bang for the buck’.”
- “You don’t want to completely outsource this, because you do want to get people involved, but [scientists] are not necessarily the best ones to design the program...If 3-5% of [small] budgets were aggregated, you could maybe run a summer workshop for teachers that you couldn’t do as an individual.”
- “[NSF should] provide ways for faculty members to group proposals or share in programs.”
- “Broader Impacts is much better done with a program that targets Broader Impacts. Then you can choose what the best way is to get the Broader Impacts.”
- Two representatives suggested the Broader Impacts be an “add-on” award, in which principal investigators apply for Broader Impacts funds on top of their already awarded proposal. Current examples given were the Research Experience for Undergraduates (REU) program and the “Communicating Science to the Public” program.

America COMPETES Reauthorization Act

All representatives support the America COMPETES Reauthorization Act language, but many of them expressed concerns over implementation.

Representatives were each asked to review a provided copy of the America COMPETES Reauthorization Act of 2010 - P.L. 111-358. Sec. 526. Broader Impacts Review criterion, (shown in Appendix C3). Every

representative reacted positively to the goals listed; however, about half of the representatives interviewed expressed concern over implementation:

- “COMPETES Act’s Broader Impacts statement will really help out quite a lot because it’s much more specific, there are more goals, the goals are more focused, and there are policy statements that go along with them.”
- “People will look at this as a check list, and it’s up to the NSF to clarify in the RFP [Request For Proposal] which of these eight goals need to be addressed for specific programs, or people may see it as another level of check lists to go through.”
- “These are so diverse that you wouldn’t expect [people to view as a check list]. But what would need to happen is that the Foundation needs to be very clear in terms of how it is asking reviewers and proposers to address Broader Impacts with regards to these goals. “
- “It needs to be very clear what the expectation is. For example, if I have a principal investigator that has a wonderful project, but can’t really figure out how [the project] really contributes to national security, the principal investigator is going to wonder if the project is going to be competitive. No one is going to submit something if they don’t think they are going to be competitive. Whatever NSF asks for, they need to be very clear how they want us to demonstrate it.”
- “I kind of like this list as long as it is made clear that you’re not expected to do all of them. Successful proposals will address one or two of them. Encourage people to focus on something that they can really do.”

Post-award Assessment

Representatives feel current post-award assessment of Intellectual Merit is adequate, but worry about any new assessment requirements.

All university representatives agreed that assessment was good, but most of them pointed out that assessments are difficult. For post-award assessment, all representatives mentioned two current mechanisms. First, publication in peer-reviewed journals is a community-valued assessment of Intellectual Merit. Second, representatives cited future proposal review as an assessment of past work. All representatives who mentioned these processes felt they provide adequate assessment. For example, one said, “While I think a lot of programs for assessment of an entire program are appropriate, I think that smaller research grants should not have a formal assessment, but maybe just a reporting of results for the next time you apply for NSF funds.”

In relation to Broader Impacts statements, representatives all said that there is not a current structure of assessing outcomes beyond future proposal review. Most representatives voiced concern over assessment implementation challenges, and their comments reflected three common questions: How is it going to be done? Who is going to do it? Who is going to pay for it?

- “Challenge is [the] time scale – it is hard to assess the impacts of individual projects on a short time scale. [It is] good to do [assessment] on an aggregate level, but at the individual level it is hard.”

- “It is all about accountability and that is a good thing. It should be tested to make sure the benefit outweighs the cost.”
- “I want NSF to be aware of time. I know money is tight, and accountability is important. How can we make it more efficient and fair to everybody? Large universities have an easier time because they have a large staff; other institutions have very small offices, and they struggle to fulfill NSF requirements.”
- “To ask scientists to spend time on assessment seems like a waste of their time. There should be funding considerations. To ask small institutions to provide support without funding stretches [the institution].”
- “As far as individual research proposals and assessment of Broader Impacts, I would just say no. It would cost money. If we’re talking about a zero sum game, I would rather that money go toward funding more research. I would just look at how we’re doing at Broader Impacts more globally.”
- “I am worried about requiring more resources be put into assessment. I am worried that we are going to be asked to do something that NSF is not going to give us more support for.”

Two representatives suggested requiring Broader Impacts reporting in annual reports; for example, one said: “If we are going to require Broader Impacts, it should be in the [annual] report. Everyone takes the reports very seriously. If Broader Impacts is part of the assessing of work (i.e., if Broader Impacts is commercialization – what steps are being taken to achieve commercialization), principal investigator needs to justify Broader Impacts.”

Two representatives suggested that assessment mechanisms be included in the proposal process. For example, one said, “I think that if NSF is serious about [assessments], they should have people include how they are going to assess their outcomes in the proposal. And then, as part of the reporting structure [annual reports], they report if the assessment criteria were measureable, and to what extent they were achieved.”

Impact of Merit Review Criteria

Most representatives say the Broader Impacts criterion has changed how people think about the scientific process.

More than three-quarters of representative said that they do think that content of the Merit Review criteria effects how scientist think and do their work; however, no one felt that people were changing the topic of their work to subjects that are perceived to have more “Broader Impacts.” Representatives said things like:

- “At first, it was hard to get a broad spectrum to participate in Broader Impacts activities...Over time I’ve seen that there is actually an active engagement in these activities. There is a large enough set of faculty who are really working on this and thinking about this on a regular basis. At first people didn’t want to shift the resources from scientific research to include these aspects, now people don’t ask these questions. Everyone realizes that it is important to do those types of things.”

- “When you have to think of half a page on Broader Impacts in your summary, then it forces your hand to address and think about what you’re going to do.”
- “A lot of our new faculty are applying for CAREER awards, and those also have a major educational component and force young faculty to think about what he or she is going to in that area in connection with the research.”

Appendix C1: Participating Institutions

Institution	Type of Institution
Barnard College	Bachelor's - 1st Prof Degree (Private)
California State University, Fullerton	Bachelor's - 1st Prof Degree (Public)
Gadsden State Community College	2 But < 4 Yr College (Public)
Massachusetts Institute of Technology	PhD and Equivalent Degree (Private)
University of Alaska Anchorage	Master's - 2nd Prof Degree (Public)
University of Arkansas	PhD and Equivalent Degree (Public)
University of Illinois at Urbana-Champaign	PhD and Equivalent Degree (Public)
University of New Mexico	PhD and Equivalent Degree (Public)
Xavier University of Louisiana	Bachelor's - 1st Prof Degree (Private)

The discussions were facilitated by Christina Freyman and Tom Slomba of SRI International.

Appendix C2: University/College Representative Interview Guide

Note: This document is designed to be used as a guide for interviews conducted with Representatives of Universities/Colleges. It is not intended to be used as a structured interview. Topics will not necessarily be addressed in the order presented below. Interviewers will probe and follow-up as needed. The purpose of this guide is to help ensure that a series of similar topics are addressed in all interviews. Check boxes are provided to assist the interviewer in making certain all topics are addressed during the interview.

Introduction – Introduce SRI Representatives and provide purpose of study.

Purpose of Study

Thank you for agreeing to be interviewed as part of our effort to obtain the views and experiences of Representatives of Universities/Colleges related to the utility of the Merit Review criteria and review Process for the NSB Task Force. As indicated in the e-mail you received from Joanne Tornow requesting your participation, as part of our study, we are also be obtaining input from other stakeholder groups including NSF Leadership and Program/Division Directors, current members of the 14 NSF Advisory Committees, Principal Investigators, and Reviewers.

If you do not object, we would like to record our interview with you. The information you provide during the course of this interview will not be attributed to you personally in our report. Any attribution would be made in a generic form such as “A current NSF official suggested....” or “A university representative reported that....”

Do we have your permission to record the interview?

Do you have any questions before we begin?

Topic 1 – Respondent Roles/ Responsibilities Related to Submission of Proposals to NSF

Before I start with the topics we’ll be discussing, could you provide a brief description of your roles and responsibilities related to the submission of proposals to NSF?

Topic 2. Strengths and Weaknesses of the NSF Merit Review criteria

Let’s start our discussion with your overall views on the strengths and weaknesses of the NSF’s current proposal merit review criteria.

Probes as needed:

- What do you see as the strengths of NSF’s criterion of Intellectual Merit?
- What do you see as the strengths of NSF’s criterion of Broader Impacts?
- What do you see as the weaknesses of NSF’s criterion of Intellectual Merit?
- What do you see as the weaknesses of NSF’s criterion of Broader Impacts?
- To what extent, if at all, has the way you think about each of NSF’s 2 Merit Review criteria evolved over time?

As necessary, review history of criteria:

NSF’s Intellectual Merit and Broader Impacts criteria were put in place in 1997. In 2001 the requirement that proposers and reviewers must address both criteria was initiated. Then in 2007 the Intellectual Merit

Review criterion was modified to specifically include the extent to which a proposal also suggests and explores potentially transformative concepts.

Topic 3. Your Institution's Role in addressing Merit Review criteria

Our next topic is – The role of your institution in addressing the 2 NSF merit criteria in submitted proposals.

Probes as needed:

- What is the current role of your institution in assuring the Intellectual Merit of the proposal?
- What is the current role of your institution in assuring that Broader Impacts are addressed in the proposal?
- What more, if anything could institutions such as yours do to help ensure that the Intellectual Merit described in a proposal is realized?
- What more, if anything could institutions such as yours do to help ensure the Broader Impacts identified in a proposal are realized?

Topic 4. NSF's Role in Enhancing the Broader Impacts and Intellectual Merit of Funded Research

Next I would like to explore your views on what additional roles, if any, NSF itself might play in enhancing the Broader Impacts and Intellectual Merit of the research it funds.

Probe as needed:

- Do you have suggestions on things NSF could do in this area?

Topic 5. Merit criteria's Impacts on how scientists think about doing their research

With some modifications, the 2 Merit criteria have been used since 1997. I would be interested in any views you may have on the extent to which, if at all, the use of the 2 criteria has changed the way scientists think about doing their research.

Probe as needed:

- What change, if any, have you seen in how proposals are written to respond to NSF's 2 Merit criteria over time?
- What changes, if any, resulted from the 2001 requirement that both Intellectual Merit and Broader Impacts must be addressed in a proposal?
- What changes, if any, resulted from the 2007 modification in the Intellectual Merit criterion to specifically include the extent to which a proposal also suggests and explores potentially transformative concepts?

As necessary, review history of criteria:

NSF's Intellectual Merit and Broader Impacts criteria were put in place in 1997. In 2001 the requirement that proposers and reviewers must address both criteria was initiated. Then in 2007 the Intellectual Merit Review criterion was modified to specifically include the extent to which a proposal also suggests and explores potentially transformative concepts.

Topic 6. Intellectual Merit and Broader Impacts criteria considerations

Next I would like to get your views on some of the guidance NSF provides regarding the 2 Merit criteria. I have a list for you that shows NSF's five considerations for each of the criterion. These are included in

the Proposal and Award Procedures Guide and are provided to Reviewers in Proposal Review Instructions. They are intended to be suggestions and may not apply to any given proposal.

Probes as needed:

- What are your views, if any, on how these Intellectual Merit considerations are used by proposers and reviewers?
- What, if anything, could be done to improve the considerations that NSF offers related to Intellectual Merit?
- What are your views, if any, on how the Broader Impacts considerations are used by proposers and reviewers?
- What, if anything could be done to improve the considerations that NSF offers related to Broader Impacts?

Background as need:

From -- NSF 10-1 January 2010 Chapter III - NSF Proposal Processing and Review - The criteria include considerations that help define them. These considerations are suggestions, and not all will apply to any given proposal. While proposers must address both merit review criteria, reviewers will be asked to address only those considerations that are relevant to the proposal being considered and for which the reviewer is qualified to make judgments.

Topic 7. Assessments of Intellectual Merit and Broader Impacts of Funded Proposals

Next I would like to discuss what happens as a result of the review process. The overall goal of the process is to ensure that the proposals funded have Intellectual Merit and will have Broader Impacts. In your view, how much of a need, if any, is there to assess or document that completed research that NSF funded actually had Intellectual Merit and/or Broader Impacts?

Probes as needed:

- Who has primary responsibility for assessing or documenting the Intellectual Merit of NSF funded proposals?
- Who has primary responsibility for assessing or documenting the Broader Impacts of NSF funded proposals?

Topic 8. The Broader Impacts Review criterion Provision in the America COMPETES Reauthorization Act of 2010

President Obama signed the America Competes Reauthorization Act into law on January 4. This law contains a provision related to NSF's Broader Impacts criterion.

Are you familiar with this provision? If so, what are your views, if any regarding this provision in the law?

Probe as needed;

- What do you anticipate will happen as a result of the requirement that, 6 months after the date of enactment of this Act, NSF Director shall develop and implement a policy for the Broader Impacts Review criterion that addresses areas such as education of PIs, Reviewers, and NSF staff, clarification of Broader Impacts activities, and provision of institutional support for the portion PIs' proposals designed to satisfy the Broader Impacts criterion?

- What are your views, if any, regarding the requirement in this law that principal investigators applying for Foundation research grants provide evidence of institutional support for the portion of their proposal designed to satisfy the Broader Impacts Review criterion?

Topic 9. Selection of Reviewers

Next, I'd like to get your opinion, if any, on the selection and recruitment of NSF reviewers.

Probes as needed:

- What changes, if any, are needed to the manner in which NSF recruits and selects proposal reviewers to ensure that the review processes effectively addresses Intellectual Merit and Broader Impacts?

Topic 10. Changes in the NSF Merit Review criteria

We have discussed a number of topics related to NSF's 2 Merit Review. What changes, if any, would you like to see made to NSF's Merit Review criteria?

Probe as needed:

- Do you have any suggestions for changes to the Intellectual Merit criterion?
- **Do** you have any suggestions for changes to the Broader Impacts criterion?
- Need for additional criteria?

Topic 11. Other Comments/Concerns

Before we end the interview - do you have any other comments or concerns about NSF's Intellectual Merit and Broader Impacts criteria or related issues?

Appendix C3: America COMPETES Reauthorization Act

America COMPETES Reauthorization Act of 2010 - *P.L. 111-358* SEC. 526.

BROADER Intellectual MeritPACTS REVIEW CRITERION.

- (a) Goals- The Foundation shall apply a Broader Impacts Review criterion to achieve the following goals:
 - (1) Increased economic competitiveness of the United States.
 - (2) Development of a globally competitive STEM workforce.
 - (3) Increased participation of women and underrepresented minorities in STEM.
 - (4) Increased partnerships between academia and industry.
 - (5) Improved pre-K-12 STEM education and teacher development.
 - (6) Improved undergraduate STEM education.
 - (7) Increased public scientific literacy.
 - (8) Increased national security.
- (b) Policy- Not later than 6 months after the date of enactment of this Act, the Director shall develop and implement a policy for the Broader Impacts Review criterion that--
 - (1) provides for educating professional staff at the Foundation, merit review panels, and applicants for Foundation research grants on the policy developed under this subsection;
 - (2) clarifies that the activities of grant recipients undertaken to satisfy the Broader Impacts Review criterion shall--
 - (A) to the extent practicable employ proven strategies and models and draw on existing programs and activities; and
 - (B) when novel approaches are justified, build on the most current research results;
 - (3) allows for some portion of funds allocated to Broader Impacts under a research grant to be used for assessment and evaluation of the Broader Impacts activity;
 - (4) encourages institutions of higher education and other nonprofit education or research organizations to develop and provide, either as individual institutions or in partnerships thereof, appropriate training and programs to assist Foundation-funded principal investigators at their institutions in achieving the goals of the Broader Impacts Review criterion as described in subsection (a); and
 - (5) requires principal investigators applying for Foundation research grants to provide evidence of institutional support for the portion of the investigator's proposal designed to satisfy the Broader Impacts Review criterion, including evidence of relevant training, programs, and other institutional resources available to the investigator from either their home institution or organization or another institution or organization with relevant expertise.

Appendix C4: Crosswalk between Interview Guide and Recurring Themes

Recurring Themes	Interview Guide Topic
Intellectual merit is well understood by principal investigators and reviewers.	Topic 2
Some representatives request more clarity on specific Intellectual Merit criterion potential considerations.	Topic 2/Topic 10
All representatives say the Broader Impacts criterion is good, but confusing.	Topic 2/Topic 6/Topic 10
Representatives have concerns over reviewers' ability to assess Broader Impacts statements.	Topic 9/Topic 10
Smaller Institutions want more guidelines and examples.	Topic 6/Topic 10
Some officials see the potential considerations under the criteria as a "check list."	Topic 6/Topic 10
All representatives see more weight being placed on Intellectual Merit over Broader Impacts.	Topic 3
Most representatives see a need to aggregate Broader Impacts activities at institution and/or NSF level.	Topic 4
All representatives support the <i>America COMPETES Reauthorization Act</i> language, but many of them expressed concerns over implementation.	Topic 8
Representatives feel current methods of Intellectual Merit assessment are adequate.	Topic 7
All representatives have concerns about any new assessment requirements.	Topic 7
Most representatives say the Broader Impacts criterion has changed how people think about the scientific process.	Topic 5

Appendix D: *Survey of NSF Officials and Advisory Committee Members*

Methodology

This survey's frame consisted of all current NSF Officials defined as Program Officers, Division Directors, and Deputy Division Directors (581 individuals) and Advisory Committee Members (234 individuals) as provided to SRI by the NSB Task Force on Merit Review in January 2011. The entire universe was sent an invitation to participate in a web survey. The survey instrument was developed and refined in consultation with the NSF and NSB Task Force on Merit Review and pretested with six individuals. Survey invitees received a presurvey email from the NSB Task Force on Merit Review, and a survey invitation plus three reminders from SRI. The preliminary email and the survey invitation included assurances that there would be no individual attribution to any survey response and that SRI as the survey administrator would maintain the confidentiality of all respondents. The survey remained open from January 28, 2011 to February 18, 2011. Usable responses were obtained from 385 NSF Officials and 111 Advisory Committee Members for response rates of 66% and 47% respectively. The overall response rate was 64%.

Because the entire population was surveyed, there are not statistical errors. However, in this survey, as in all surveys, there are several other possible sources of error that are probably more serious than that of sampling error. They include but are not limited to non-response and measurement errors such as question wording and question order. It is difficult or impossible to quantify the errors that may result from these factors.

Survey Instrument

Pages 65-89

Survey on the Use and Utility of the National Science Foundation Merit Review Criteria

Thank you for participating in our survey.

The National Science Board (NSB) is currently undertaking a thorough review of the two merit review criteria (Intellectual Merit and Broader Impacts). As part of that review, the NSB Task Force on Merit Review has contracted with SRI International to assist in gathering and analyzing input from various stakeholders on a number of issues related to the two criteria. These issues include how the criteria are interpreted by both external communities and internal NSF staff, as well as how the criteria are used in the preparation and review of proposals, and in making funding decisions.

The SRI study team designed this survey to obtain input from the NSF Program Officers, Division Directors, and Advisory Committee Members.

There will be no individual attribution to any survey response. SRI as the survey administrator will maintain the confidentiality of all respondents. Any survey data provided to anyone outside of SRI, including NSF or the NSB, will be purged of information that could be used to identify individual responses. Please note:

- This survey contains both structured and open-ended questions; it should take about 15 – 30 minutes of your time to complete, depending on your responses to open-ended questions.
- This survey will be open through February 18th, 2011.
- When you complete the survey, please click the "SUBMIT" button at the end.
- If you do not complete the entire survey and choose to return to it at a later time, you will be taken to the point where you left off by clicking the button "Resume survey."
- Please click the button "NEXT" to proceed to the survey.

If you have any technical questions about the web survey, please contact Roland Bardon at NSF_Merit_Review@sri.com or 703-247-8545. If you have general questions about the study, please contact me at jongwon.park@sri.com or 703-247-8550.

Sincerely,

Jongwon Park,
Study Director
SRI International

There are 31 questions in this survey, however you will automatically be skipped past some questions that do not apply to you.

There are 32 questions in this survey

Criteria Guidance Provided By NSF

1 In the Grants Proposal Guide, NSF provides the following list of potential considerations for the Intellectual Merit criterion:

- **How important is the proposed activity to advancing knowledge and understanding within its own field or across different fields?**
- **How well qualified is the proposer (individual or team) to conduct the project? (If appropriate, the reviewer will comment on the quality of prior work.)**
- **To what extent does the proposed activity suggest and explore creative, original, or potentially transformative concepts?**
- **How well conceived and organized is the proposed activity?**
- **Is there sufficient access to resources?**

How would you rate this list as guidance for PIs in formulating proposals?-- and for reviewers in assessing proposals?

Please choose the appropriate response for each item:

	Excellent	Good	Fair	Poor	Very poor	No basis to judge
For PIs in formulating proposals	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
For reviewers in assessing proposals	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

2 In the Grants Proposal Guide NSF also provides the following list of potential considerations for the Broader Impacts criterion:

- How well does the activity advance discovery and understanding while promoting teaching, training, and learning?
- How well does the proposed activity broaden the participation of underrepresented groups (such as gender, ethnicity, disability, geographic, etc.)?
- To what extent will it enhance the infrastructure for research and education, such as facilities, instrumentation, networks, and partnerships?
- Will the results be disseminated broadly to enhance scientific and technological understanding?
- What may be the benefits of the proposed activity to society?

How would you rate this list as guidance for PIs in formulating proposals? -- and for reviewers in assessing proposals?

Please choose the appropriate response for each item:

	Excellent	Good	Fair	Poor	Very poor	No basis to judge
For PIs in formulating proposals	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
For reviewers in assessing proposals	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

3 What suggestions, if any, would you offer to improve the guidance NSF provides to PIs and reviewers in its Grant Proposal Guide regarding the Intellectual Merit and Broader Impacts criteria, including revisions or additions to the lists of potential considerations identified in the previous questions?

Please write your answer(s) here:

Suggestions
for improving
guidance on
Intellectual
Merit criterion

{NOTEMPTY}

including the
list of
potential
considerations

Suggestions
for improving
guidance on
Broader
Impacts
criterion
including the
list of
potential
considerations

{NOTEMPTY}

Understanding of Merit Review Criteria

4 How would you rate the overall level of understanding of the Intellectual Merit and Broader Impacts criteria exhibited by members of the reviewer community during the past 2 year period?

Please choose the appropriate response for each item:

	Very high level	High level	Moderate level	Low level	Very low level	No basis to judge
Intellectual Merit criterion understanding	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Broader Impacts criterion understanding	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

5 How would you rate the overall level of understanding of the Intellectual Merit and Broader Impacts criteria exhibited by members of the PI community during the past 2 year period?

Please choose the appropriate response for each item:

	Very high level	High level	Moderate level	Low level	Very low level	No basis to judge
Intellectual Merit criterion understanding	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Broader Impacts criterion understanding	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Weight Placed on Criteria

6 From your perspective, during the past 2 years, relatively how much weight have reviewers typically placed on the Intellectual Merit criterion vs. the Broader Impacts criterion?

Please choose **only one** of the following:

- Much more weight on Intellectual Merit
- More weight on Intellectual Merit
- Somewhat more weight on Intellectual Merit
- Both equally
- Somewhat more weight on Broader Impacts
- More weight on Broader Impacts
- Much more weight on Broader Impacts
- No basis to judge
- Other - Please explain

7 In your opinion, typically, how much weight should reviewers place on the Intellectual Merit criterion vs. the Broader Impacts criterion?

Please choose **only one** of the following:

- Much more weight on Intellectual Merit
- More weight on Intellectual Merit
- Somewhat more weight on Intellectual Merit
- Both equally
- Somewhat more weight on Broader Impacts
- More weight on Broader Impacts
- Much more weight on Broader Impacts
- No basis to judge
- Other - Please explain

Role of PIs' Institutions

8 In your opinion, should PIs' institutions play a greater or lesser role in supporting the portion of PIs' proposals designed to satisfy the Intellectual Merit and Broader Impacts criteria?

Please choose the appropriate response for each item:

	Much greater	Somewhat greater	Stay the same	Somewhat less	Much less	No basis to judge
Intellectual Merit	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Broader Impacts	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Role of PIs' Institutions (cont.)

9 What steps, if any, should NSF take to increase the role PIs' Institutions play in supporting the Intellectual Merit and Broader Impacts of the proposals it funds?

Only answer this question if the following conditions are met:

° Answer was 'Stay the same' or 'No basis to judge' or 'Much less' or 'Somewhat less' or 'Much greater' or 'Somewhat greater' at question '8 [Q8]' (In your opinion, should PIs' institutions play a greater or lesser role in supporting the portion of PIs' proposals designed to satisfy the Intellectual Merit and Broader Impacts criteria? (Intellectual Merit))

Please write your answer(s) here:

Steps NSF
should
take to
increase
Institutions'
role in
Intellectual
Merit

--

Steps NSF
should
take to
increase
Institutions'
role in
Broader
Impacts

--

Assessment of Attainment of Criteria Goals

10 In your opinion, should NSF do more or less than it is currently doing to assess whether or not the goals of Intellectual Merit and Broader Impacts were realized in the completed research it funded?

Please choose the appropriate response for each item:

	Much more	Somewhat more	Stay the same	Somewhat less	Much less	No basis to judge
Assess Intellectual Merit	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Assess Broader Impacts	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Assessment of Attainment of Criteria Goals (cont.)

11 What suggestions, if any, do you have for ways NSF could do more to assess whether or not the goals of Intellectual Merit and Broader Impacts of the NSF funded research, were realized?

Only answer this question if the following conditions are met:

o

----- Scenario 1 -----

Answer was 'Much more' or 'Somewhat more' at question '10 [Q10]' (In your opinion, should NSF do more or less than it is currently doing to assess whether or not the goals of Intellectual Merit and Broader Impacts were realized in the completed research it funded? (Assess Intellectual Merit))

----- or Scenario 2 -----

Answer was 'Much more' or 'Somewhat more' at question '10 [Q10]' (In your opinion, should NSF do more or less than it is currently doing to assess whether or not the goals of Intellectual Merit and Broader Impacts were realized in the completed research it funded? (Assess Broader Impacts))

Please write your answer(s) here:

Ways to
assess
whether or
not
Intellectual
Merit
goals of
funded
research
were
realized

--

Ways to
assess
whether or
not
Broader
Impact
goals of
funded
research
were
realized

--



Strengths and Weaknesses of Merit Criteria

12 What do you view as the major strengths, if any, of the Intellectual Merit and Broader Impacts criteria?

Please write your answer(s) here:

Major
Strengths
of
Intellectual
Merit
criterion

--

Major
Strengths
of Broader
Impacts
criterion

--

13 What do you view as the major weaknesses, if any, of the Intellectual Merit and Broader Impacts criteria?

Please write your answer(s) here:

Major
Weaknesses
of
Intellectual
Merit
criterion

--

Major
Weaknesses
of Broader
Impacts
criterion

--

14 In proposal funding considerations you made over the past 2 years as a

Program or Division Director, what weight did you typically place on the Intellectual Merit criterion compared to Broader Impacts criterion?

Please choose **only one** of the following:

- Much more weight on Intellectual Merit
- More weight on Intellectual Merit
- Somewhat more weight on Intellectual Merit
- Both equally
- Somewhat more weight on Broader Impacts
- More weight on Broader Impacts
- Much more weight on Broader Impacts
- Not Applicable – made no funding considerations as Program Officer or Division Director over the past 2 years
- Other - Please explain

15 In considering funding for NSF proposals for FY 2011, what weight do you think should typically be placed on the Intellectual Merit criterion compared to the Broader Impacts criterion by Program Officers and Division Directors?

Please choose **only one** of the following:

- Much more weight on Intellectual Merit
- More weight on Intellectual Merit
- Somewhat more weight on Intellectual Merit
- Both equally
- Somewhat more weight on Broader Impacts
- More weight on Broader Impacts
- Much more weight on Broader Impacts
- No basis to judge
- Other - Please explain

Additional Comments

16 If you have any additional comments, including suggested improvements to the Merit Review criteria or related issues, please provide them below.

Please write your answer here:

Background

17 Which of the following positions do you currently hold with the NSF?

Please choose **only one** of the following:

- Program Officer
- Division Director
- Deputy Division Director
- Advisory Committee Member
- Other

Background (cont.)

18 Is your position permanent or rotational?

Only answer this question if the following conditions are met:

° Answer was NOT 'Advisory Committee Member' at question '17 [Q17]' (Which of the following positions do you currently hold with the NSF?)

Please choose **only one** of the following:

- Permanent
- Rotational/Temporary (Intergovernmental Personnel Act (IPA) assignments or Visiting Scientists, Engineers and Educators (VSEE) assignments)
- Other - Please explain

19 To what extent, if at all, does your position address the areas listed below?

Only answer this question if the following conditions are met:

° Answer was NOT 'Advisory Committee Member' at question '17 [Q17]' (Which of the following positions do you currently hold with the NSF?)

Please choose the appropriate response for each item:

	Great extent	Some extent	Minor extent	Not at all
Individual or small team research funding	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Large centers research funding	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Promoting interdisciplinary activities	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Diversity/broader participation of women and under-represented minorities	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Research/outreach programs/K-12 schools and students	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Education (fellowship) and training	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Infrastructure building (equipment and facility)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Institutional/regional research capability building	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Innovation program (SBIR, STTR, PFI, etc.)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>



20 How long have you held your current NSF position?

Only answer this question if the following conditions are met:

° Answer was NOT 'Advisory Committee Member' at question '17 [Q17]' (Which of the following positions do you currently hold with the NSF?)

Please choose **only one** of the following:

- Less than 1 year
- 1 – 3 years
- 3 – 5 years
- 5 – 10 years
- More than 10 years

21 In total, how long have you worked for NSF?

Only answer this question if the following conditions are met:

° Answer was NOT 'Advisory Committee Member' at question '17 [Q17]' (Which of the following positions do you currently hold with the NSF?)

Please choose **only one** of the following:

- Less than 1 year
- 1 – 3 years
- 3 – 5 years
- 5 – 10 years
- 10 - 15 years
- More than 15 years

Background (cont.)

The following demographic questions are asked for statistical purposes. Your responses are voluntary.

22 What is your Ethnicity?

Only answer this question if the following conditions are met:

° Answer was NOT 'Advisory Committee Member' at question '17 [Q17]' (Which of the following positions do you currently hold with the NSF?)

Please choose **only one** of the following:

- Hispanic or Latino
- Not Hispanic or Latino

23 What is your race?

Only answer this question if the following conditions are met:

° Answer was NOT 'Advisory Committee Member' at question '17 [Q17]' (Which of the following positions do you currently hold with the NSF?)

Please choose **all** that apply:

- American Indian or Alaska Native
- Asian
- Black or African American
- Native Hawaiian or Other Pacific Islander
- White

24 What is your gender?

Only answer this question if the following conditions are met:

° Answer was NOT 'Advisory Committee Member' at question '17 [Q17]' (Which of the following positions do you currently hold with the NSF?)

Please choose **only one** of the following:

- Female
- Male

25 How many years ago did you receive your terminal/professional degree?

Only answer this question if the following conditions are met:

° Answer was NOT 'Advisory Committee Member' at question '17 [Q17]' (Which of the following positions do you currently hold with the NSF?)

Please choose **only one** of the following:

- Less than 1 year

- 1 – 3 years
- 3 – 5 years
- 5 – 10 years
- 10 - 15 years
- More than 15 years
- Not applicable

Background - Advisory Committee Member

26 Which of the following NSF positions, if any, have you held in the past?

Only answer this question if the following conditions are met:

° Answer was 'Advisory Committee Member' at question '17 [Q17]' (Which of the following positions do you currently hold with the NSF?)

Please choose **only one** of the following:

Program Officer

Division Director

Deputy Division Director

None

Other - Please explain

Background - Advisory Committee Member (cont.)

27 In total, how long did you work for NSF?

Only answer this question if the following conditions are met:

° Answer was 'Advisory Committee Member' at question '17 [Q17]' (Which of the following positions do you currently hold with the NSF?) *and* Answer was 'Program Officer' or 'Division Director' or 'Deputy Division Director' or 'None' at question '26 [Q26]' (Which of the following NSF positions, if any, have you held in the past?)

Please choose **only one** of the following:

- Less than 1 year
- 1 – 3 years
- 3 – 5 years
- 5 – 10 years
- 10 - 15 years
- More than 15 years

Background - Advisory Committee Member (cont.)

The following demographic questions are asked for statistical purposes. Your responses are voluntary.

28 What is your Ethnicity?

Only answer this question if the following conditions are met:

° Answer was 'Advisory Committee Member' at question '17 [Q17]' (Which of the following positions do you currently hold with the NSF?)

Please choose **only one** of the following:

- Hispanic or Latino
- Not Hispanic or Latino

29 What is your race?

Only answer this question if the following conditions are met:

° Answer was 'Advisory Committee Member' at question '17 [Q17]' (Which of the following positions do you currently hold with the NSF?)

Please choose **all** that apply:

- American Indian or Alaska Native
- Asian
- Black or African American
- Native Hawaiian or Other Pacific Islander
- White

30 What is your gender?

Only answer this question if the following conditions are met:

° Answer was 'Advisory Committee Member' at question '17 [Q17]' (Which of the following positions do you currently hold with the NSF?)

Please choose **only one** of the following:

- Female
- Male

31 How many years ago did you receive your terminal/professional degree?

Only answer this question if the following conditions are met:

° Answer was 'Advisory Committee Member' at question '17 [Q17]' (Which of the following positions do you currently hold with the NSF?)

Please choose **only one** of the following:

- Less than 1 year

- 1 – 3 years
- 3 – 5 years
- 5 – 10 years
- 10 - 15 years
- More than 15 years
- Not applicable

Survey Submittal

32 Thank you for completing the survey. When you are ready to submit your answers, please click on the "Submit" button below.

27.05.2011 – 00:00
Submit your survey.
Thank you for completing this survey.

Results

Simple Frequency and Means

All=all respondents; AC=Advisory Committee, PO=Program Officer, DD=Division Director & Deputy Division Directors; NSF=PO+DD; Permanent and Rotator/Temporary are breakdowns of the NSF subgroup.										
Please note: None of the question were mandatory, so response count vary from question to question. Questions 18-25 were only for NSF employees. Q26-31 were only for Advisory Committee members.										
Question 1. In the Grant Proposal Guide, NSF provides the following list of potential considerations for the Intellectual Merit criterion: How would you rate this list as guidance for PIs/Reviewers in formulating proposals?										
	For PIs in formulating proposals	All	NSF	AC	DD	PO	Permanent	Rotator/Temporary		
5	Excellent	43.6%	47.5%	35.5%	61.5%	45.3%	50.7%	41.3%		
4	Good	44.5%	41.7%	51.8%	30.8%	43.4%	37.0%	48.7%		
3	Fair	9.4%	8.7%	11.8%	0.0%	10.1%	8.5%	10.0%		
2	Poor	0.9%	1.1%	0.9%	1.9%	0.9%	1.9%	0.0%		
1	Very Poor	0.4%	0.3%	0.0%	1.9%	0.0%	0.5%	0.0%		
-	No basis to judge	1.1%	0.8%	0.0%	3.8%	0.3%	1.4%	0.0%		
	Total Count of Responses	532	379	110	52	327	211	150		
	MEAN (Std Dev)	4.32 (0.71)	4.36 (0.71)	4.22 (0.68)	4.54 (0.79)	4.33 (0.69)	4.38 (0.76)	4.33 (0.64)		
For reviewers in assessing proposals										
5	Excellent	47.0%	49.9%	41.4%	63.5%	47.7%	53.8%	43.0%		
4	Good	41.7%	40.9%	42.3%	23.1%	43.7%	35.8%	48.3%		
3	Fair	8.5%	7.1%	12.6%	5.8%	7.3%	8.0%	6.7%		
2	Poor	1.5%	1.1%	2.7%	1.9%	0.9%	0.5%	2.0%		
1	Very Poor	0.4%	0.3%	0.9%	1.9%	0.0%	0.5%	0.0%		
-	No basis to judge	0.9%	0.8%	0.0%	3.8%	0.3%	1.4%	0.0%		
	Count of Responses	532	379	111	52	327	212	149		
	MEAN (Std Dev)	4.35 (0.73)	4.4 (0.69)	4.21 (0.83)	4.5 (0.86)	4.39 (0.66)	4.45 (0.7)	4.33 (0.68)		

Question 2. In the Grant Proposal Guide, NSF provides the following list of potential considerations for the Broader Impacts criterion: How would you rate this list as guidance for PIs/Reviewers in formulating proposals?								
	For PIs in formulating proposals	All	NSF	AC	DD	PO	Permanent	Rotator/ Temporary
5	Excellent	25.0%	26.1%	24.6%	19.2%	27.2%	26.5%	24.0%
4	Good	41.8%	43.5%	37.3%	46.2%	43.1%	41.2%	46.7%
3	Fair	24.5%	22.7%	28.2%	19.2%	23.2%	22.7%	23.3%
2	Poor	6.6%	5.8%	9.1%	7.7%	5.5%	6.2%	6.0%
1	Very Poor	1.1%	1.3%	0.9%	3.8%	0.9%	2.4%	0.0%
-	No basis to judge	0.9%	0.5%	0.0%	3.8%	0.0%	1.0%	0.0%
	Count of Responses	531	379	110	52	327	211	150
	MEAN (Std Dev)	3.84 (0.92)	3.88 (0.91)	3.75 (0.96)	3.72 (1.01)	3.9 (0.89)	3.85 (0.97)	3.9 (0.83)
For reviewers in assessing proposals								
	For reviewers in assessing proposals	All	NSF	AC	DD	PO	Permanent	Rotator/ Temporary
5	Excellent	26.3%	26.1%	27.9%	19.2%	27.1%	26.4%	24.7%
4	Good	42.0%	45.0%	32.4%	44.2%	45.1%	41.0%	50.0%
3	Fair	21.4%	20.8%	21.6%	17.3%	21.3%	23.6%	17.3%
2	Poor	7.7%	5.8%	15.3%	7.7%	5.5%	5.7%	6.7%
1	Very Poor	1.9%	1.8%	2.7%	7.7%	0.9%	2.4%	1.3%
-	No basis to judge	0.8%	0.5%	0.0%	3.8%	0.0%	0.9%	0.0%
	Count of Responses	533	380	111	52	328	212	150
	MEAN (Std Dev)	3.84 (0.97)	3.88 (0.93)	3.68 (1.12)	3.62 (1.14)	3.92 (0.88)	3.85 (0.96)	3.91 (0.88)

Question 4. How would you rate the overall level of understanding of the Intellectual Merit and Broader Impacts criteria exhibited by members of the reviewer community during the past 2 year period?									
	Intellectual Merit criterion Understanding	All	NSF	AC	DD	PO	Permanent	Rotator/ Temporary	
5	Very high level	40.2%	42.4%	35.8%	47.2%	41.6%	44.1%	38.2%	
4	High level	43.3%	45.5%	36.7%	39.6%	46.5%	45.5%	47.4%	
3	Moderate level	9.9%	8.9%	13.8%	5.7%	9.4%	7.1%	11.2%	
2	Low level	0.9%	0.5%	2.8%	0.0%	0.6%	0.0%	1.3%	
1	Very low level	0.4%	0.5%	0.0%	1.9%	0.3%	0.5%	0.7%	
-	No basis to judge	5.3%	2.1%	11.0%	5.7%	1.5%	2.8%	1.3%	
	Count of Responses	527	382	109	53	329	211	152	
	MEAN (Std Dev)	4.29 (0.72)	4.32 (0.7)	4.19 (0.81)	4.38 (0.78)	4.31 (0.69)	4.38 (0.66)	4.24 (0.75)	
Broader Impacts criterion Understanding									
	Broader Impacts criterion Understanding	All	NSF	AC	DD	PO	Permanent	Rotator/ Temporary	
5	Very high level	6.3%	6.5%	4.5%	5.7%	6.7%	6.6%	5.3%	
4	High level	22.2%	24.6%	13.6%	26.4%	24.3%	23.6%	25.2%	
3	Moderate level	41.7%	45.5%	33.6%	34.0%	47.4%	43.4%	47.7%	
2	Low level	18.6%	16.2%	27.3%	15.1%	16.4%	18.9%	14.6%	
1	Very low level	6.3%	5.0%	10.0%	13.2%	3.6%	4.7%	6.0%	
-	No basis to judge	5.1%	2.1%	10.9%	5.7%	1.5%	2.8%	1.3%	
	Count of Responses	528	382	110	53	329	212	151	
	MEAN (Std Dev)	3.04 (0.98)	3.12 (0.94)	2.72 (1.02)	2.96 (1.12)	3.14 (0.9)	3.1 (0.95)	3.13 (0.92)	

Question 5. How would you rate the overall level of understanding of the Intellectual Merit and Broader Impacts criteria exhibited by members of the PI community during the past 2 year period?									
	Intellectual Merit criterion Understanding	All	NSF	AC	DD	PO	Permanent	Rotator/ Temporary	
5	Very high level	35.7%	36.2%	38.5%	48.1%	34.3%	38.4%	33.1%	
4	High level	42.4%	44.9%	33.9%	32.7%	46.8%	44.5%	45.7%	
3	Moderate level	15.8%	15.0%	19.3%	11.5%	15.5%	12.8%	17.2%	
2	Low level	1.1%	1.0%	1.8%	0.0%	1.2%	0.5%	2.0%	
1	Very low level	0.6%	0.8%	0.0%	1.9%	0.6%	1.0%	0.7%	
-	No basis to judge	4.4%	2.1%	6.4%	5.8%	1.5%	2.8%	1.3%	
	Count of Responses	526	381	109	52	329	211	151	
	MEAN (Std Dev)	4.17 (0.78)	4.17 (0.78)	4.17 (0.82)	4.33 (0.85)	4.15 (0.77)	4.23 (0.76)	4.09 (0.8)	
Broader Impacts criterion Understanding									
	Broader Impacts criterion Understanding	All	NSF	AC	DD	PO	Permanent	Rotator/ Temporary	
5	Very high level	3.8%	3.9%	3.6%	5.7%	3.7%	4.3%	2.0%	
4	High level	16.5%	17.6%	10.9%	22.6%	16.8%	19.4%	16.6%	
3	Moderate level	45.5%	48.3%	41.8%	30.2%	51.2%	46.4%	48.3%	
2	Low level	21.6%	21.3%	22.7%	18.9%	21.6%	19.0%	25.8%	
1	Very low level	8.3%	6.8%	14.5%	17.0%	5.2%	8.1%	6.0%	
-	No basis to judge	4.2%	2.1%	6.4%	5.7%	1.5%	2.8%	1.3%	
	Count of Responses	527	381	110	53	328	211	151	
	MEAN (Std Dev)	2.85 (0.94)	2.9 (0.91)	2.64 (1.01)	2.8 (1.18)	2.92 (0.86)	2.94 (0.95)	2.84 (0.85)	

Question 6. From your perspective, during the past 2 years, relatively how much weight have reviewers typically placed on the Intellectual Merit criterion vs. the Broader Impacts criterion?									
	Weight Typically Placed	All	NSF	AC	DD	PO	Permanent	Rotator/ Temporary	
7	Much more weight on Intellectual Merit	40.5%	37.4%	49.5%	37.7%	37.3%	36.4%	41.4%	
6	More weight on Intellectual Merit	37.5%	41.6%	28.8%	37.7%	42.2%	42.1%	42.1%	
5	Somewhat more weight on Intellectual Merit	6.8%	7.8%	4.5%	3.8%	8.4%	7.0%	5.9%	
4	Both equally	3.0%	3.6%	1.8%	7.5%	3.0%	4.2%	2.6%	
3	Somewhat more weight on Broader Impacts	1.1%	0.8%	0.9%	0.0%	0.9%	1.4%	0.0%	
2	More weight on Broader Impacts	0.4%	0.3%	0.9%	0.0%	0.3%	0.5%	0.0%	
1	Much more weight on Broader Impacts	0.4%	0.3%	0.9%	0.0%	0.3%	0.5%	0.0%	
-	No basis to judge	4.5%	2.1%	8.1%	5.7%	1.5%	2.3%	1.3%	
	Other - Please explain	5.8%	6.2%	4.5%	7.5%	6.0%	5.6%	6.6%	
	Count of Responses	531	385	111	53	332	214	152	
	MEAN (Std Dev)	6.23 (0.95)	6.19 (0.9)	6.35 (1.05)	6.22 (0.89)	6.19 (0.9)	6.13 (0.99)	6.29 (0.76)	

Question 7. In your opinion, typically, how much weight should reviewers place on the Intellectual Merit criterion vs. the Broader Impacts criterion?									
	Weight that Should be Placed	All	NSF	AC	DD	PO	Permanent	Rotator/ Temporary	
7	Much more weight on Intellectual Merit	15.6%	12.7%	22.5%	15.1%	12.3%	12.6%	14.5%	
6	More weight on Intellectual Merit	31.3%	33.2%	25.2%	28.3%	34.0%	32.7%	36.8%	
5	Somewhat more weight on Intellectual Merit	21.5%	22.6%	19.8%	26.4%	22.0%	20.1%	25.7%	
4	Both equally	15.4%	14.5%	19.8%	17.0%	14.2%	14.5%	11.8%	
3	Somewhat more weight on Broader Impacts	1.1%	0.8%	2.7%	0.0%	0.9%	0.5%	1.3%	
2	More weight on Broader Impacts	0.8%	0.3%	1.8%	0.0%	0.3%	0.5%	0.0%	
1	Much more weight on Broader Impacts	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	
-	No basis to judge	2.3%	1.8%	0.9%	5.7%	1.2%	1.9%	1.3%	
	Other - Please explain	12.1%	14.0%	7.2%	7.5%	15.1%	17.3%	8.6%	
	Count of Responses	531	385	111	53	332	214	152	
	MEAN (Std Dev)	5.5 (1.08)	5.5 (1)	5.43 (1.26)	5.48 (1.01)	5.5 (1)	5.49 (1.02)	5.51 (0.98)	

Question 8. In your opinion, should PIs' institutions play a greater or lesser role in supporting the portion of PIs' proposals designed to satisfy the Intellectual Merit and Broader Impacts criteria?									
	Intellectual Merit criterion	All	NSF	AC	DD	PO	Permanent	Rotator/ Temporary	
5	Much Greater	5.0%	5.0%	5.5%	3.8%	5.2%	6.3%	3.3%	
4	Somewhat Greater	23.0%	27.6%	11.0%	23.1%	28.3%	25.0%	30.7%	
3	Stay the Same	55.3%	52.8%	65.1%	61.5%	51.4%	51.4%	56.0%	
2	Somewhat Less	2.7%	1.6%	5.5%	1.9%	1.5%	2.4%	0.7%	
1	Much Less	1.5%	1.6%	0.9%	1.9%	1.5%	1.9%	0.7%	
-	No basis to judge	12.5%	11.4%	11.9%	7.7%	12.0%	13.0%	8.7%	
	Count of Responses	521	377	109	52	325	208	150	
	MEAN (Std Dev)	3.31 (0.7)	3.37 (0.7)	3.17 (0.68)	3.27 (0.68)	3.39 (0.71)	3.36 (0.75)	3.38 (0.64)	
	Broader Impacts criterion	All	NSF	AC	DD	PO	Permanent	Rotator/ Temporary	
5	Much Greater	29.4%	30.8%	25.0%	35.8%	29.9%	30.5%	32.2%	
4	Somewhat Greater	39.2%	38.5%	43.5%	35.8%	38.9%	35.2%	43.6%	
3	Stay the Same	14.8%	15.1%	16.7%	13.2%	15.4%	16.2%	12.8%	
2	Somewhat Less	2.5%	2.7%	1.9%	1.9%	2.8%	2.9%	2.7%	
1	Much Less	1.5%	1.1%	1.9%	1.9%	0.9%	1.4%	0.0%	
-	No basis to judge	12.5%	11.9%	11.1%	11.3%	12.0%	13.8%	8.7%	
	Count of Responses	520	377	108	53	324	210	149	
	MEAN (Std Dev)	4.06 (0.88)	4.08 (0.86)	3.99 (0.86)	4.15 (0.91)	4.07 (0.86)	4.04 (0.9)	4.14 (0.8)	

Question 10. In your opinion, should NSF do more or less than it is currently doing to assess whether or not the goals of Intellectual Merit and Broader Impacts were realized in the completed research it funded?									
	Assess Intellectual Merit Goals	All	NSF	AC	DD	PO	Permanent	Rotator/ Temporary	
5	Much more	12.8%	12.8%	11.7%	17.3%	12.1%	14.2%	11.3%	
4	Somewhat more	30.3%	32.2%	26.1%	19.2%	34.2%	30.7%	31.8%	
3	Stay the same	49.9%	49.5%	54.1%	53.8%	48.8%	47.6%	53.6%	
2	Somewhat less	0.6%	0.5%	0.9%	0.0%	0.6%	0.9%	0.0%	
1	Much less	1.0%	1.0%	0.9%	1.9%	0.9%	1.9%	0.0%	
-	No basis to judge	5.5%	3.9%	6.3%	7.7%	3.3%	4.7%	3.3%	
	Count of Responses	525	382	111	52	330	212	151	
	MEAN (Std Dev)	3.56 (0.77)	3.57 (0.77)	3.5 (0.76)	3.54 (0.87)	3.58 (0.75)	3.57 (0.82)	3.59 (0.69)	
Assess Broader Impacts Goals									
	All	All	NSF	AC	DD	PO	Permanent	Rotator/ Temporary	
5	Much more	27.8%	25.4%	38.7%	34.0%	24.0%	27.1%	24.8%	
4	Somewhat more	34.5%	36.9%	27.0%	26.4%	38.6%	32.2%	38.9%	
3	Stay the same	28.0%	30.1%	21.6%	28.3%	30.4%	31.8%	29.5%	
2	Somewhat less	2.3%	1.8%	4.5%	1.9%	1.8%	1.9%	2.0%	
1	Much less	1.7%	1.6%	1.8%	1.9%	1.5%	1.9%	1.3%	
-	No basis to judge	5.7%	4.2%	6.3%	7.5%	3.6%	5.1%	3.4%	
	Count of Responses	525	382	111	53	329	214	149	
	MEAN (Std Dev)	3.89 (0.92)	3.86 (0.89)	4.03 (1.01)	3.96 (0.98)	3.85 (0.87)	3.85 (0.92)	3.88 (0.85)	

Question 14. In proposal funding considerations you made over the past 2 years as a Program or Division Director, what weight did you typically place on the Intellectual Merit criterion compared to Broader Impacts criterion?								
	Weight You Placed	All	NSF	AC	DD	PO	Permanent	Rotator/ Temporary
7	Much more weight on Intellectual Merit	8.1%	8.9%	5.7%	11.3%	8.5%	9.8%	7.9%
6	More weight on Intellectual Merit	31.4%	35.7%	17.1%	24.5%	37.5%	35.0%	39.1%
5	Somewhat more weight on Intellectual Merit	19.8%	24.7%	5.7%	18.9%	25.7%	22.0%	25.8%
4	Both equally	11.4%	13.3%	6.7%	15.1%	13.0%	14.5%	10.6%
3	Somewhat more weight on Broader Impacts	0.8%	1.0%	0.0%	0.0%	1.2%	0.5%	2.0%
2	More weight on Broader Impacts	0.4%	0.5%	0.0%	1.9%	0.3%	0.9%	0.0%
1	Much more weight on Broader Impacts	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
-	Other - Please explain	10.9%	12.8%	4.8%	17.0%	12.1%	15.0%	9.9%
-	Not Applicable – made no funding considerations as Program Officer or Division Director over the past 2 years	17.2%	3.1%	60.0%	11.3%	1.8%	2.3%	4.6%
	Count of Responses	516	384	105	53	331	214	151
	MEAN (Std Dev)	5.47 (0.96)	5.43 (0.96)	5.62 (0.98)	5.37 (1.15)	5.44 (0.94)	5.44 (1)	5.44 (0.91)

Question 15. In considering funding for NSF proposals for FY 2011, what weight do you think should typically be placed on the Intellectual Merit criterion compared to the Broader Impacts criterion by Program Officers and Division Directors?									
Weight Should Have Been Placed	All	NSF	AC	DD	PO	Permanent	Rotator/Temporary		
7	Much more weight on Intellectual Merit	10.6%	8.1%	18.0%	5.7%	8.5%	9.4%	6.7%	
6	More weight on Intellectual Merit	32.7%	34.6%	26.1%	35.8%	34.5%	31.1%	42.7%	
5	Somewhat more weight on Intellectual Merit	22.5%	22.8%	24.3%	17.0%	23.8%	22.6%	21.3%	
4	Both equally	15.6%	16.5%	14.4%	20.8%	15.9%	16.5%	14.0%	
3	Somewhat more weight on Broader Impacts	1.7%	1.3%	3.6%	0.0%	1.5%	0.5%	2.7%	
2	More weight on Broader Impacts	1.2%	0.3%	3.6%	0.0%	0.3%	0.5%	0.0%	
1	Much more weight on Broader Impacts	0.4%	0.3%	0.9%	0.0%	0.3%	0.5%	0.0%	
-	Other - Please explain	12.1%	14.4%	4.5%	13.2%	14.6%	16.5%	12.0%	
-	No basis to judge	3.3%	1.6%	4.5%	7.5%	0.6%	2.4%	0.7%	
	Count of Responses	520	381	111	53	328	212	150	
	MEAN (Std Dev)	5.35 (1.11)	5.36 (1.01)	5.29 (1.36)	5.33 (0.95)	5.36 (1.02)	5.36 (1.05)	5.37 (0.96)	

Question 17: Which of the following positions do you currently hold with the NSF?									
	All	NSF	DD	PO	Permanent	Rotator/Temporary			
Program Officer	63.8%	86.2%	0.0%	100.0%	82.7%	90.8%			
Division Director	6.2%	8.3%	60.4%	0.0%	7.9%	9.2%			
Deputy Division Director	4.0%	5.5%	39.6%	0.0%	9.3%	0.0%			
Advisory Committee Member	21.3%								
Other	4.6%								
Count of Responses	520	385	53	332	214	152			

Questions 18-25 were only for NSF employees							
Question 18: Is your position permanent or rotational?	All	NSF	DD	PO	Permanent	Rotator/ Temporary	
Permanent	55.3%	56.0%	69.8%	53.8%	100.0%	0.0%	
Rotational/Temporary	37.7%	39.8%	26.4%	42.0%	0.0%	100.0%	
Other - Please explain	7.1%	4.2%	3.8%	4.3%	0.0%	0.0%	
Count of Responses	409	382	53	329	214	152	

Question 19. In your position at NSF, to what extent, if at all, are you involved in the management of the programmatic areas listed below?							
Individual or small team research funding	All	NSF	DD	PO	Permanent	Rotator/ Temporary	
Great extent	72.2%	75.0%	78.4%	74.5%	76.8%	74.3%	
Some extent	13.7%	13.2%	9.8%	13.7%	11.8%	13.8%	
Minor extent	7.8%	7.0%	2.0%	7.8%	5.9%	7.9%	
Not at all	6.3%	4.8%	9.8%	4.0%	5.4%	3.9%	
Count of Responses	395	372	51	321	203	152	
MEAN (Std Dev)	2.71 (0.59)	2.69 (0.62)	2.57 (0.94)	2.59 (0.8)	2.6 (0.83)	2.56 (0.82)	

Large centers research funding							
All	NSF	DD	PO	Permanent	Rotator/ Temporary		
16.3%	16.3%	32.7%	13.7%	19.9%	12.5%		
27.2%	27.3%	22.4%	28.1%	31.8%	21.5%		
29.5%	29.8%	32.7%	29.4%	29.4%	29.9%		
26.9%	26.5%	12.2%	28.8%	18.9%	36.1%		
386	362	49	313	201	144		
1.82 (0.77)	1.82 (0.77)	1.76 (1.05)	1.27 (1.02)	1.51 (1.01)	1.08 (1.03)		

Promoting interdisciplinary activities		All	NSF	DD	PO	Permanent	Rotator/ Temporary
3	Great extent	45.2%	46.5%	64.0%	43.8%	53.4%	38.4%
2	Some extent	41.7%	41.7%	24.0%	44.4%	36.9%	47.0%
1	Minor extent	10.3%	9.9%	6.0%	10.5%	7.3%	13.2%
0	Not at all	2.8%	1.9%	6.0%	1.2%	2.4%	1.3%
	Count of Responses	398	374	50	324	206	151
	MEAN (Std Dev)	2.37 (0.66)	2.36 (0.67)	2.46 (0.86)	2.31 (0.71)	2.4 (0.73)	2.3-2.5
Diversity/broader participation of women and under-represented minorities							
	All		NSF	DD	PO	Permanent	Rotator/ Temporary
3	Great extent	33.3%	33.3%	46.2%	31.3%	34.0%	31.6%
2	Some extent	46.3%	46.7%	44.2%	47.1%	45.3%	49.3%
1	Minor extent	18.5%	18.6%	7.7%	20.4%	18.9%	18.4%
0	Not at all	2.0%	1.3%	1.9%	1.2%	1.9%	0.7%
	Count of Responses	406	381	52	329	212	152
	MEAN (Std Dev)	2.15 (0.71)	2.15 (0.71)	2.35 (0.71)	2.09 (0.75)	2.12 (0.77)	2.12 (0.72)
Research/outreach programs/ K-12 schools and students							
	All		NSF	DD	PO	Permanent	Rotator/ Temporary
3	Great extent	17.1%	17.7%	18.0%	17.6%	18.9%	14.0%
2	Some extent	29.2%	30.0%	26.0%	30.7%	28.2%	32.0%
1	Minor extent	41.1%	41.6%	48.0%	40.6%	43.2%	42.0%
0	Not at all	12.6%	10.7%	8.0%	11.1%	9.7%	12.0%
	Count of Responses	397	373	50	323	206	150
	MEAN (Std Dev)	1.73 (0.77)	1.73 (0.77)	1.54 (0.89)	1.55 (0.91)	1.59 (0.92)	1.48 (0.89)

	Education (fellowship) and training						Rotator/Temporary
	All	NSF	DD	PO	Permanent		orary
3	26.7%	27.6%	33.3%	26.7%	28.6%	25.8%	
2	33.7%	34.0%	29.4%	34.7%	33.3%	33.1%	
1	28.2%	27.9%	27.5%	27.9%	29.0%	27.2%	
0	11.5%	10.6%	9.8%	10.7%	9.0%	13.9%	
	401	377	51	326	210	151	
	Infrastructure building (equipment and facility)						Rotator/Temporary
	All	NSF	DD	PO	Permanent		Temporary
3	15.9%	15.9%	22.0%	15.0%	20.7%	7.3%	
2	25.6%	25.6%	22.0%	26.2%	24.1%	29.3%	
1	28.4%	28.6%	30.0%	28.3%	28.1%	27.3%	
0	30.1%	29.9%	26.0%	30.5%	27.1%	36.0%	
	395	371	50	321	203	150	
	1.82 (0.78)	1.82 (0.78)	1.4 (1.11)	1.26 (1.05)	1.39 (1.09)	1.1 (0.98)	
	Institutional/regional research capability building						Rotator/Temporary
	All	NSF	DD	PO	Permanent		Temporary
3	8.0%	8.3%	8.2%	8.3%	9.5%	6.8%	
2	23.8%	24.0%	28.6%	23.2%	22.6%	25.2%	
1	35.9%	37.2%	34.7%	37.6%	40.2%	32.0%	
0	32.3%	30.6%	28.6%	30.9%	27.6%	36.1%	
	387	363	49	314	199	147	
	1.58 (0.7)	1.59 (0.69)	1.16 (0.94)	1.09 (0.93)	1.14 (0.93)	1.04 (0.93)	

	Innovation program (SBIR, STTR, PFI, etc.)	All	NSF	DD	PO	Permanent	Rotator/ Temporary
3	Great extent	5.7%	5.5%	12.2%	4.5%	7.5%	2.7%
2	Some extent	10.1%	9.9%	16.3%	8.9%	9.0%	10.9%
1	Minor extent	26.9%	27.8%	30.6%	27.4%	26.1%	29.9%
0	Not at all	57.4%	56.7%	40.8%	59.2%	57.3%	56.5%
	Count of Responses	387	363	49	314	199	147
	MEAN (Std Dev)	1.48 (0.71)	1.5 (0.72)	1 (1.04)	0.59 (0.83)	0.67 (0.92)	0.59 (0.8)

	Promoting international collaboration	All	NSF	DD	PO	Permanent	Rotator/ Temporary
3	Great extent	14.9%	14.7%	21.6%	13.7%	15.5%	14.7%
2	Some extent	37.4%	38.1%	39.2%	37.9%	38.8%	38.0%
1	Minor extent	33.6%	33.8%	31.4%	34.2%	34.5%	30.0%
0	Not at all	14.1%	13.4%	7.8%	14.3%	11.2%	17.3%
	Count of Responses	396	373	51	322	206	150
	MEAN (Std Dev)	1.78 (0.72)	1.78 (0.72)	1.75 (0.89)	1.51 (0.9)	1.59 (0.88)	1.48 (0.94)

	Q20: How long have you held your current NSF position?	All	NSF	DD	PO	Permanent	Rotator/ Temporary
1	Less than 1 year	20.1%	20.5%	25.0%	19.8%	5.2%	43.3%
2	1 – 3 years	35.5%	35.3%	21.2%	37.5%	22.6%	51.3%
3	3 – 5 years	10.7%	9.7%	19.2%	8.2%	13.2%	4.0%
4	5 – 10 years	18.1%	18.4%	19.2%	18.3%	30.7%	1.3%
5	More than 10 years	15.6%	16.1%	15.4%	16.2%	28.3%	0.0%
	Count of Responses	403	380	52	328	212	150
	MEAN (Std Dev)	2.74 (1.38)	2.74 (1.39)	2.79 (1.42)	2.73 (1.39)	3.52 (1.26)	1.68 (0.68)

Q21: In total, how long have you worked for NSF?		All	NSF	DD	PO	Permanent	Rotator/ Temporary
1	Less than 1 year	17.1%	17.5%	17.0%	17.6%	2.3%	40.4%
2	1 – 3 years	26.7%	27.2%	11.3%	29.8%	12.6%	45.0%
3	3 – 5 years	9.4%	9.2%	5.7%	9.7%	8.4%	9.9%
4	5 – 10 years	20.3%	19.9%	11.3%	21.3%	30.8%	3.3%
5	10 – 15 years	10.9%	11.0%	18.9%	9.7%	19.2%	0.7%
6	More than 15 years	15.6%	15.2%	35.8%	11.9%	26.6%	0.7%
	Count of Responses	404	382	53	329	214	151
	MEAN (Std Dev)	3.28 (1.71)	3.25 (1.71)	4.11 (1.93)	3.11 (1.63)	4.29 (1.4)	1.85 (0.89)

Q22: What is your Ethnicity?		All	NSF	DD	PO	Permanent	Rotator/ Temporary
	Hispanic or Latino	5.2%	5.1%	2.0%	5.6%	6.6%	3.5%
	Not Hispanic or Latino	94.8%	94.9%	98.0%	94.4%	93.4%	96.5%
	Count of Responses	383	355	51	304	196	141

Q23: What is your race? (Could choose more than 1)		All	NSF	DD	PO	Permanent	Rotator/ Temporary
	Q23 [American Indian or Alaska Native]	0.5%	0.6%	0.0%	0.7%	0.5%	0.7%
	Q23 [Asian]	9.2%	9.9%	12.2%	9.5%	7.1%	15.0%
	Q23 [Black or African American]	5.2%	4.2%	0.0%	4.9%	3.6%	5.7%
	Q23 [Native Hawaiian or Other Pacific Islander]	0.3%	0.3%	0.0%	0.3%	0.5%	0.0%
	Q23 [White]	84.0%	83.1%	87.8%	82.3%	85.7%	77.1%
	Multiple Responses	1.8%	2.0%	0%	2.3%	3.6%	2.8%
	Count of Respondents	382	354	49	305	196	140

Q24: What is your gender?		All	NSF	DD	PO	Permanent	Rotator/ Temporary
Male		60.7%	59.8%	60.8%	59.7%	57.7%	62.0%
Female		39.3%	40.2%	39.2%	40.3%	42.3%	38.0%
Count of Responses		384	356	51	305	196	142

Q25: How many years ago did you receive your terminal/professional degree?		All	NSF	DD	PO	Permanent	Rotator/ Temporary
Less than 1 year		0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
1 – 3 years		0.8%	0.5%	0.0%	0.6%	1.0%	0.0%
3 – 5 years		0.3%	0.3%	0.0%	0.3%	0.5%	0.0%
5 – 10 years		4.1%	3.5%	0.0%	4.1%	2.0%	6.2%
10 – 15 years		10.9%	11.2%	7.8%	11.7%	11.8%	9.7%
More than 15 years		83.5%	84.5%	92.2%	83.2%	84.8%	84.1%
Count of Responses		395	367	51	316	204	145
MEAN (Std Dev)		5.77 (0.6)	5.79 (0.57)	5.92 (0.27)	5.77 (0.58)	5.81 (0.56)	5.78 (0.54)
Two-sided confidence limit for the mean (95%)		5.71-5.83	5.73-5.85	5.85-6	5.71-5.84	5.73-5.88	5.69-5.86

Questions 26-31 were for Advisory Committee Members only

Q26. Which of the following NSF positions, if any, have you held in the past?	AC
Program Officer	4.6%
Deputy Division Director	0.9%
None	84.4%
Other - Please explain	10.1%
Response Count	109

Q27: In total, how long did you work for the NSF?		AC
1	Less than 1 year	21.6%
2	1 – 3 years	43.3%
3	3 – 5 years	18.6%
4	5 – 10 years	10.3%
5	10 - 15 years	4.1%
6	More than 15 years	2.1%
	Response Count	97
	MEAN (Std Dev)	2.38 (1.18)

Q28: What is your ethnicity?		AC
	Hispanic or Latino	7.7%
	Not Hispanic or Latino	92.3%
	Response Count	104

Q29: What is your race?		AC
	Q23 [American Indian or Alaska Native]	5.8%
	Q23 [Asian]	4.9%
	Q23 [Black or African American]	10.7%
	Q23 [Native Hawaiian or Other Pacific Islander]	0.0%
	Q23 [White]	76.7%
	Multiple Responses	1.9%
	Respondent Count	103

Q30: What is your gender?		AC
	Male	54.3%
	Female	45.7%
	Response Count	105

Q31: How many years ago did you receive your terminal/professional degree?	AC
Less than 1 year	0.0%
1 – 3 years	0.0%
3 – 5 years	0.0%
5 – 10 years	0.9%
10 - 15 years	6.4%
More than 15 years	91.7%
Not applicable	0.9%
Response Count	109
MEAN (Std Dev)	5.92 (0.31)

Expanded Analysis – criterion weighting as a function of Programmatic Activities (Question 19)

Question 19. In your position at NSF, to what extent, if at all, are you involved in the management of the programmatic areas listed below? (for all NSF respondents)

Respondents who indicated they are involved in the management of the following categories to a "great extent"			
Programmatic Area	Count	Total Respondents	Percentage (%)
Individual or small team research funding	279	372	75%
Large centers research funding	59	362	16.3%
Promoting interdisciplinary activities	174	374	46.5%
Diversity/broader participation of women and under-represented minorities	127	381	33.3%
Research/outreach programs/K-12 schools and students	66	373	17.7%
Education (fellowship) and training	104	377	27.6%
Infrastructure building (equipment and facility)	59	371	15.9%
Institutional/regional research capability building	30	363	8.3%
Innovation program (SBIR, STTR, PFI, etc.)	20	363	5.5%
Promoting international collaboration	55	373	14.7%

Figure 1 shows the percentage of each group that indicated that they place more weight on Intellectual Merit or each weight on Intellectual Merit or Broader Impacts. **Figure 2** shows the percentage of each group that indicated what weighting should be placed on the two criteria.

Figure 1. In proposal funding considerations you made over the past 2 years as a Program or Division Director, what weight did you typically place on the Intellectual Merit criterion compared to Broader Impacts criterion?

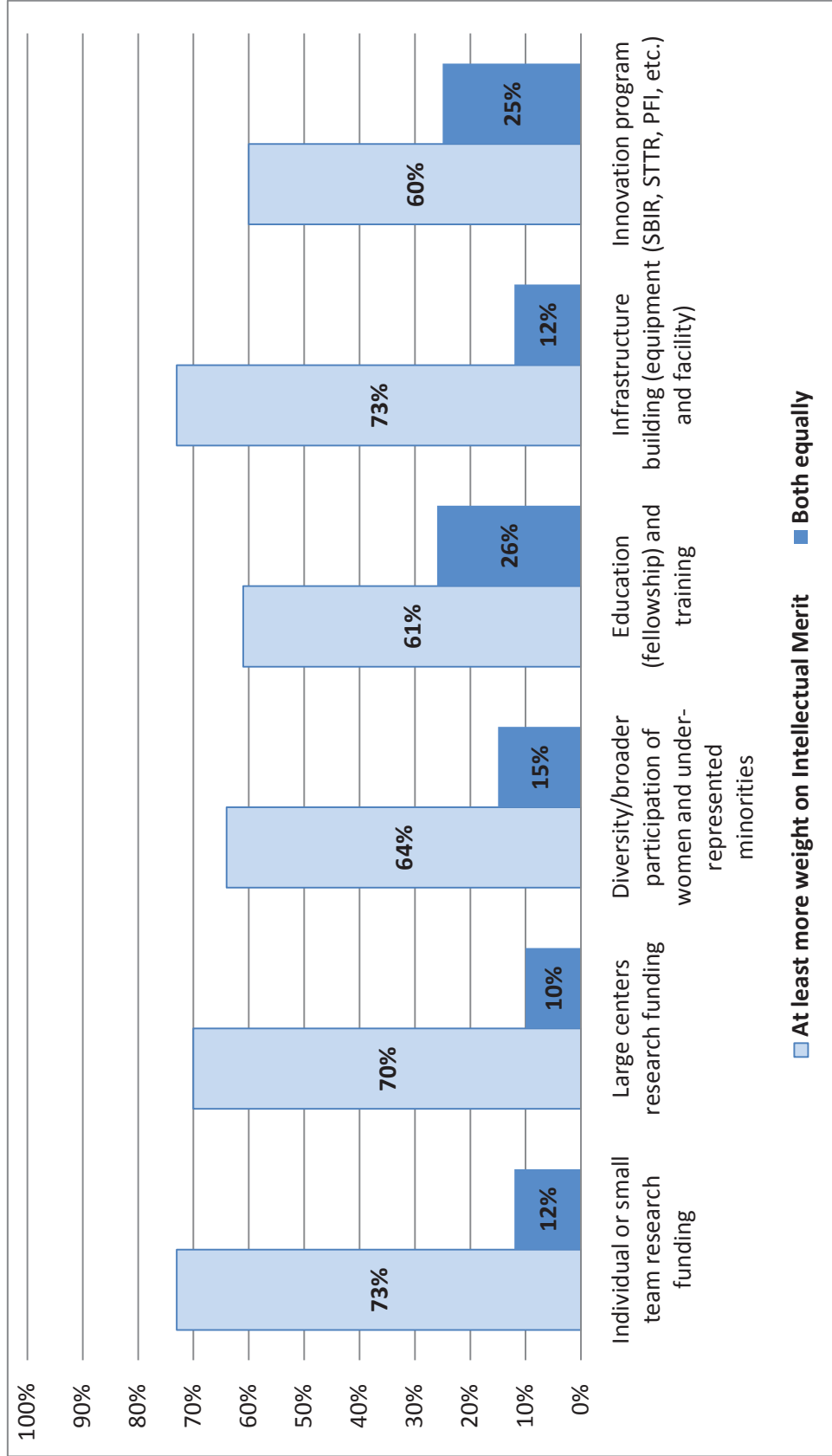
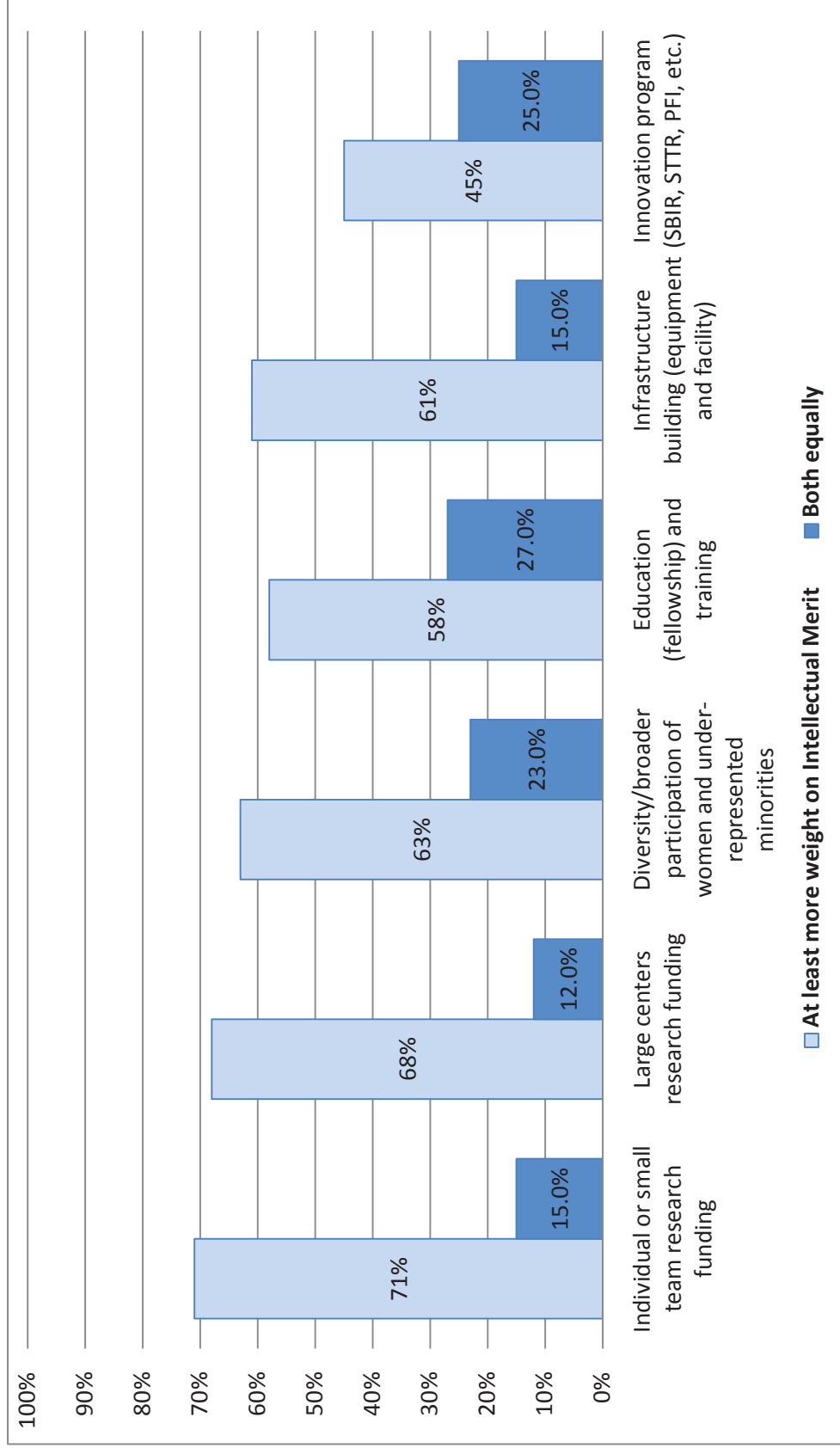


Figure 2. In considering funding for FY 2011, what weight do you think should typically be placed on the Intellectual Merit criterion compared to the Broader Impacts criterion by Program Officers and Division Directors?



Analysis of Open-ended Questions

Improving Guidance

A total of 229 survey respondents wrote in an answer other than none or no suggestions to the open-ended question 3(a): “What suggestions, if any, would you offer to improve the guidance NSF provides to PIs and reviewers in its Grant Proposal Guide regarding the Intellectual Merit criterion, including revisions or additions to the lists of potential considerations identified in the previous questions?” Themes are summarized in Table 1. (Multiple themes were found in answers, so the total theme count is larger than total count of responds. A theme was included once it appeared in five or more answers. 229 comments are included below.)

Table 1. *What suggestions, if any, would you offer to improve the guidance NSF provides to principal investigators and reviewers in its Grant Proposal Guide regarding the Intellectual Merit criterion, including revisions or additions to the lists of potential considerations identified in the previous questions?*

Theme	Frequency (of 229)
Intellectual Merit guidance should clarify/emphasize the transformative research potential consideration.	57
Intellectual Merit guidance should emphasize the importance of the proposals’ impact on scientific research.	43
NSF should consider reducing the number of potential considerations and/or guidance should specify the weighting and prioritization of considerations.	40
Intellectual Merit guidance should emphasize the importance of an organized, detailed research plan (costs, goals, methodology, evaluation).	27
Intellectual Merit guidance should provide specific examples for each potential consideration as well as clarify how many (all, one?) potential considerations must be addressed.	26
Intellectual Merit guidance should place less emphasis on prior work and/or qualifications.	17
Intellectual Merit guidance should clarify the “access to resources” potential consideration.	15
NSF should provide extensive instructions for proposers on the Intellectual Merit criterion including if addressing all potential considerations is required and examples.	14
Intellectual Merit guidance should emphasize the importance of proposer’s qualifications and prior research.	13
Intellectual Merit criterion should not include a potential consideration on transformative research – it is interpreted too broadly and/or results in bias against incremental research.	13
Intellectual Merit criterion guidance should specifically address non-traditional grants such as learning or work force grants.	10
Intellectual Merit potential considerations should include collaborative research.	7
Intellectual Merit potential considerations should include the plausibility of research given	6

the effort/resources.

A total of 324 survey respondents wrote in an answer other than none or no suggestions to the open-ended question 3(b): “What suggestions, if any, would you offer to improve the guidance NSF provides to principal investigators and reviewers in its Grant Proposal Guide regarding the Broader Impacts criterion, including revisions or additions to the lists of potential considerations identified in the previous questions?” Themes are summarized in Table 2. (Multiple themes were found in answers, so the total theme count is larger than total count of respondents. A theme was included once it appeared in five or more answers. 323 responses are included below.)

Table 2. *What suggestions, if any, would you offer to improve the guidance NSF provides to principal investigators and reviewers in its Grant Proposal Guide regarding the Broader Impacts criterion, including revisions or additions to the lists of potential considerations identified in the previous questions?*

Theme	Frequency (of 323)
Broader Impacts guidance should clarify how many (all, one?) Broader Impacts potential considerations must be addressed.	113
NSF should provide extensive clarification and training for reviewers on the application of the Broader Impacts criterion.	109
NSF should provide extensive instructions for proposers on the Broader Impacts criterion including specific suggestions, examples, FAQs, and best practices.	72
NSF should require specific, detailed Broader Impacts activities/action plans which include assessment criteria that would be used for post-award evaluation.	46
Broader Impacts guidance should emphasize that proposers must show how proposed research will affect education.	41
Broader Impacts guidance should emphasize that proposers must show how their proposal will affected diversity and underrepresentation.	32
Broader Impacts guidance should emphasize that proposers must show the societal impacts of proposed research and should clarify what qualifies.	31
Broader Impacts considerations should include infrastructure improvement and industry partnerships.	28
Broader Impacts guidance should emphasize that proposers must include dissemination plans.	26
Broader Impacts guidance should emphasize that principal investigators must go "above and beyond" (not what they already do).	25
Guidance should emphasize that Broader Impacts activities should tie into the scientific proposal.	19
Broader Impacts guidance should discourage the use of boilerplate responses.	16
Broader Impacts guidance should address bias toward certain types of research (pure science, non-educators, long-term broader impacts).	15

Broader Impacts guidance should include a consideration based on how the research ties into other research/disciplines.	14
Broader Impacts guidance should instruct proposers and reviewers to allow for flexibility in Broader Impacts and to not allow Broader Impacts activities to overburden the principal investigator.	11

Other weighting

Question 6 asked: “From your perspective, during the past 2 years, relatively how much weight have reviewers typically placed on the Intellectual Merit criterion vs. the Broader Impacts criterion”. Thirty (30) people choose “Other – Please explain.” Twenty-one (21) of those explanations said that it depends on the program. Four said only Intellectual Merit was judged, while five said they did not know the weighting reviewers typically placed.

Question 7 asked: “In your opinion, typically, how much weight should reviewers place on the Intellectual Merit vs. the Broader Impacts?” Sixty-four (64) respondents choose “Other – Please explain.” Of these explanations, forty wrote that it depends on the program; seven wrote that the current approach is flawed in some way; eight wrote that Intellectual Merit is required for Broader Impacts; two comments said that reviewers should choose; two comments said there should be no weighting; and two comments were off topic.

Role of Principal Investigator’s Institution

A total of 117 survey respondents wrote in an answer other than none or no suggestions to the open-ended question 9(a): “What steps, if any, should NSF take to increase the role principal investigators’ institutions play in supporting the Intellectual Merit of the proposals it funds?” Themes are summarized in Table 3. (Multiple themes were found in answers, so the total theme count is larger than total count of responses. A theme was included once it appeared in five or more answers. 109 comments are included below.)

Table 3. *What steps, if any, should NSF take to increase the role principal investigators institutions play in supporting the Intellectual Merit of the proposals it funds?*

Theme	Frequency (of 109)
NSF should encourage better pre-submission oversight/support by institutions (quality over quantity) maybe by limiting the number of research proposals by institution based on type, performance, etc.	26
NSF should cap indirect cost and/or require institutions to provide accounting for indirect costs to force institutions to spend all indirect funding on supporting the research.	24
NSF should establish a clear cost-sharing mechanism to pay for salaries, equipment, travel, training, etc.	22
NSF should encourage universities to provide grant writing training and mentoring to their principal investigators.	21

NSF should require principal investigators to outline their institution's role/relevance in their proposals.	14
NSF should require institutions support principal investigator professional development and networking with indirect funds.	11
NSF should audit institutions for compliance with award terms.	11
NSF should clarify criteria through marketing/awareness initiatives ("Dear Colleague" letter).	8

A total of 266 survey respondents wrote in an answer other than none or no suggestions to the open-ended question 9(b): "What steps, if any, should NSF take to increase the role principal investigators institutions play in supporting the Broader Impacts of the proposals it funds?" Themes are summarized in Table 4. (Multiple themes were found in answers, so the total theme count is larger than total count of responds. All themes are included below.)

Table 4. *What steps, if any, should NSF take to increase the role principal investigators' institutions play in supporting the Broader Impacts of the proposals it funds?"*

Theme	Frequency (of 226)
NSF should clarify and encourage the institution's role in supporting Broader Impacts activities by rewarding proposals that demonstrate institutional support for activities through a letter or other documentation.	124
NSF should help institutions develop materials and training to clarify what Broader Impacts mean.	63
NSF help institutions identify and publicize existing institutional programs and resources to support Broader Impacts activities rather than inventing new ones as well as identify and publicize "best practices" of Broader Impacts activity implementation.	38
NSF should hold institutions responsible for Broader Impacts activities post-award assessment.	31
NSF should required cost sharing (in money and/or labor) of Broader Impacts activities.	24
NSF should require institutions/departments to submit Broader Impacts activity assessment plans.	18
NSF should facilitate partnerships between institutions and outside groups such as schools, industry, etc.	16
NSF should require institutions to create dedicated staff position(s) for Broader Impacts activities.	15
NSF should require a dedicated budget line for Broader Impacts activities.	12
NSF should require institutions not proposers, to implement Broader Impacts activities.	9
NSF should require institutions to pay for Broader Impacts activities out of overhead/indirect cost monies.	7
NSF should reward institutions with past achievements in Broader Impacts activities.	6

Post-award Assessment

A total of 190 survey respondents wrote in an answer other than none or no suggestions to the open-ended question 11(a): “What suggestions, if any, do you have for ways NSF could do more to assess whether or not the goals of Intellectual Merit of the NSF funded research were realized?” Themes are summarized in Table 5. (Multiple themes were found in answers, so the total theme count is larger than total count of responses. A theme was included once it appeared in five or more answers. 188 responses are included below.)

Table 5. *What suggestions, if any, do you have for ways NSF could do more to assess whether or not the goals of Intellectual Merit of the NSF funded research were realized?*

Theme	Frequency (of 188)
NSF should revise the annual/final reporting process (i.e., instructions, template standardization, and submittal procedure) to enable efficient evaluation of the entire NSF portfolio.	44
NSF should assess long- term impacts by enabling principal investigators to report products (papers, patents, graduate students’ paths, theories, and/or new ideas) for many years after the award closes and use this data for long-term evaluation.	43
NSF should address issue of program officer and program director time and resource constraints to allow for more post-award monitoring (limit workload/submissions; increase staff, travel expenses, and training; enable more program officer-principal investigator communication).	33
NSF should improve accountability by clearly outlining standards and requirements and then auditing awardees for compliance.	29
NSF should enable the efficient comparison of annual reports to proposed work plan.	29
NSF should improve search and tracking functions of submissions and grants (IT systems).	23
NSF should require an evaluation metric as part of proposal, and then require the use and reporting of the evaluation metric.	15
NSF should offer financial incentives for principal investigators to comply with requirements (i.e., withholding a portion of the grant until some goals are met or giving a “bonus” award).	11
NSF should fund evaluation proposals, contracts, and workshops	10
NSF should emphasize the evaluation of past award performance in the evaluation of future awards.	8
NSF should make the data and evaluation results available to the public.	7

A total of 241 survey respondents wrote in an answer other than none or no suggestions to the open-ended question 11(b): “What suggestions, if any, do you have for ways NSF could do more to assess whether or not the goals of Broader Impacts of the NSF funded research were realized?” Themes are summarized in Table 6. (Multiple themes were found in answers, so the total theme count is larger than total count of responses. A theme was included once it appeared in five or more answers. 236 comments are included below.)

Table 6. *What suggestions, if any, do you have for ways NSF could do more to assess whether or not the goals of Broader Impacts of the NSF funded research were realized?*

Theme	Frequency (of 236)
NSF should revise the annual/final reporting process to include an explicit Broader Impacts section.	72
NSF should assess long- term impacts by enabling principal investigators to report outcomes (infrastructure, education initiatives, graduate students paths and demographics) for many years after the award closes as well as in the project reports and use these data for evaluation.	53
NSF should enable the efficient comparison of annual reports to proposed Broader Impacts activity plans.	43
NSF should improve accountability by clearly outlining standards and requirements and then auditing awardees for compliance.	41
NSF should address issue of program officer and program director time and resource constraints to allow for more post-award monitoring (limit workload/submissions; increase staff, travel expenses, and training; enable more program officer-principal investigator communication).	26
NSF should emphasize the evaluation of past award Broader Impacts in the evaluation of future awards.	21
NSF should require an evaluation metric as part of proposal, and then require the use and reporting of the evaluation metric.	21
NSF should improve search and tracking functions of submissions and grants (IT systems).	19
NSF should develop a metric to measure both quantitative and qualitative outcomes.	17
NSF should fund committees, proposals, contracts, and workshops on the evaluation of Broader Impacts activities.	17
NSF should offer financial incentives for principal investigators to implement Broader Impacts activities (i.e., withholding a portion of the grant until some goals are met or giving a “bonus” award).	16
NSF should incorporate institutions as stakeholders in the assessment process (data collection and analysis, tracking, reporting).	12
NSF should assess Broader Impacts activity as a portfolio of activities, not just a single project activity.	5

Strengths of Criteria

A total of 322 survey respondents wrote in an answer other than none or no suggestions to the open-ended question 12(a): “What do you view as the major strengths, if any, of the Intellectual Merit criterion?”

Themes are summarized in Table 7. (Multiple themes were found in answers, so the total theme count is larger than total count of responses. A theme was included once it appeared in five or more answers. 320 comments are included below.)

Table 7. *What do you view as the major strengths, if any, of the Intellectual Merit criterion?*

Theme	Frequency (of 320)
The Intellectual Merit criterion ensures that high quality research is being funded.	82
The Intellectual Merit criterion encourages original, innovative, and transformative research.	67
The Intellectual Merit criterion is easy for reviewers/principal investigators to understand because of clear expectations/procedures.	66
The Intellectual Merit criterion aligns with the mission of NSF.	57
The Intellectual Merit criterion emphasizes advancing scientific knowledge/understanding.	49
The Intellectual Merit criterion encourages strong technical proposals (goals, methodology, evaluation, risk, societal impact).	41
The Intellectual Merit criterion is broad, flexible, comprehensive, and widely accepted.	36
The Intellectual Merit criterion requires qualified principal investigators (prior research, publications, and patents).	18
The Intellectual Merit criterion requires sufficient access to resources.	7
The Intellectual Merit criterion offers detailed descriptions and various questions/examples as guidelines.	6

A total of 330 survey respondents wrote in an answer other than none or no suggestions to the open-ended question 12(b): “What do you view as the major strengths, if any, of the Broader Impacts criterion?”

Themes are summarized in Table 8. (Multiple themes were found in answers, so the total theme count is larger than total count of responses. A theme was included once it appeared in five or more answers. 325 comments are included below.)

Table 8. *What do you view as the major strengths, if any, of the Broader Impacts criterion?*

Theme	Frequency (of 325)
The Broader Impacts criterion ensures the consideration of the connection between scientific work and society.	158
The Broader Impacts criterion strives to advance STEM teaching, learning, and training in addition to science.	57
The Broader Impacts criterion strives to ensure diversity and participation of	45

underrepresented groups.	
The Broader Impacts criterion strives to encourage outreach and community engagement with stakeholders.	34
The Broader Impacts criterion reflects the fact taxpayer money is funding proposals.	31
The Broader Impacts criterion strives to ensure the dissemination of findings/results to the broader community.	28
The Broader Impacts criterion is appropriately broad and flexible.	22
The Broader Impacts criterion encourages strong technical proposals for Broader Impacts activities (goals, methodology, and evaluation).	13
The Broader Impacts criterion emphasizes improvements in research/education infrastructure.	9
The Broader Impacts criterion provides a focal point for the exploration of Broader Impacts activities.	7

Weaknesses of criteria

A total of 194 survey respondents wrote in an answer other than none or no suggestions to the open-ended question 13(a): “What do you view as the major weaknesses, if any, of the Intellectual Merit criterion?” Themes are summarized in Table 9. (Multiple themes were found in answers, so the total theme count is larger than total count of responses. A theme was included once it appeared in five or more answers. 184 comments are included below.)

Table 9. What do you view as the major weaknesses, if any, of the Intellectual Merit criterion?

Theme	Frequency (of 194)
The Intellectual Merit criterion "transformative" potential consideration is not well-defined and hard to assess.	32
The Intellectual Merit criterion is too vague and needs to be more clearly written.	22
The Intellectual Merit criterion’s emphasis on principal investigator qualifications creates bias against new principal investigators.	21
The weightings of the Intellectual Merit criterion potential considerations are unclear.	15
The Intellectual Merit criterion is interpreted too rigidly, and reviewers use it as a check list.	13
The Intellectual Merit criterion gives more priority to low-risk research over transformative research.	13
The Intellectual Merit criterion has a lack of emphasis on sound research objectives, methodology, and evaluation plan.	13
The Intellectual Merit criterion potential consideration on “resource access” creates institutional bias and is unclear.	13
The Intellectual Merit criterion overlooks incremental research and/or overemphasizes	12

transformational research.	
The Intellectual Merit criterion is difficult to apply objectively.	11
The Intellectual Merit criterion ignores multi-disciplinary projects.	10
The Intellectual Merit criterion is hard to apply to social science projects such as education.	6

A total of 332 survey respondents wrote in an answer other than none or no suggestions to the open-ended question 13(b): “What do you view as the major weaknesses, if any, of the Broader Impacts criterion?” Themes are summarized in Table 10. (Multiple themes were found in answers, so the total theme count is larger than total count of responses. A theme was included once it appeared in five or more answers. 328 comments are included below.)

Table 10. *What do you view as the major weaknesses, if any, of the Broader Impacts criterion?*

Theme	Frequency (of 328)
The Broader Impacts criterion is misunderstood by principal investigators or reviewers because it is too broad, arbitrary, and not well-defined.	125
The Broader Impacts potential criterion considerations are not taken seriously and/or proposals propose things that never are implemented.	61
The Broader Impacts criterion is difficult to evaluate due to timescale issues, subjectivity, and a lack of quantifiable metrics.	42
The Broader Impacts criterion does not require a specific objective, rational, or implementation and evaluation plan of Broader Impacts activities.	41
Principal investigators do not have the time/expertise to accomplish Broader Impacts activities, resulting in inefficiencies.	35
The Broader Impacts criterion is confusing because of wording and/or layout.	34
The Broader Impacts criterion potential considerations are interpreted narrowly favoring one/few of bullets and/or ignoring others (i.e., lots of proposals include just K-12 education).	27
The Broader Impacts criterion is overlooked in favor of the Intellectual Merit criterion.	26
The Broader Impacts criterion does not taken into account the differing types of institutions or grants.	17
Broader Impacts criterion results in less Intellectual Merit activities being done.	15
The Broader Impacts criterion has a lack of emphasis on social impact/benefits.	14
The Broader Impacts criterion does not focus strongly enough in broadening participation.	13
The Broader Impacts criterion does not emphasize dissemination of results – of the research and of the Broader Impacts activities.	13
The Broader Impacts criterion does not have clear examples of appropriate Broader Impacts activities.	12
Lack of indicated weighting of the Broader Impacts potential considerations leads to	11

inconsistent evaluations.	
The Broader Impacts criterion does not require the proposer to clearly indicate the connection between their research and their Broader Impacts activities.	10
The Broader Impacts criterion potential considerations are treated like a checklist and/or principal investigators and reviewers feel that each one has to be address for proposal to be fundable.	9

Other weighting

Question 14 asked: “In proposal funding considerations you made over the past 2 years as a Program or Division Director, what weight did you typically place on the Intellectual Merit criterion compared to Broader Impacts criterion?” Fifty-six (56) respondents choose “Other – Please explain.” Of those comments, 33 said it depends on the program, while 12 comments said that Intellectual Merit is required for Broader Impacts to occur. The remaining 11 were off topic.

Question 15 asked: “In considering funding for NSF proposals for FY 2011, what weight do you think should typically be placed on the Intellectual Merit criterion compared to the Broader Impacts criterion by Program Officers and Division Directors?” Sixty-two (62) respondents choose “Other – Please explain.” Forty-one (41) comments said that it depends on the program, while seven comments said the Merit Review criteria should be revised. Six comments said that Intellectual Merit is required for Broader Impacts, and eight were off topic.

Additional Comments

A total of 147 survey respondents wrote in an answer other than none or no suggestions to the open-ended question 16, which stated: “If you have any additional comments, including suggested improvements to the Merit Review criteria or related issues, please provide them below.” Themes are summarized in Table 11. (Multiple themes were found in answers, so the total theme count is larger than total count of responses. A theme was included once it appeared in five or more answers. 139 comments are included below.)

Table 11. *If you have any additional comments, including suggested improvements to the Merit Review criteria or related issues, please provide them below.*

Theme	Frequency (of 139)
NSF should improve oversight/enforcement/assessment with universal standards and greater post-award attention.	34
The Intellectual Merit portion of the proposal should take precedence over the Broader Impacts portion of the proposal.	30
NSF should provide better guidelines (i.e., instructions, descriptions, FAQ, examples).	28
The relative weights of Intellectual Merit and Broader Impacts need to be clarified.	19
The Merit Review criteria should be flexible, and NSF should specify how it should be applied for different types of institutions/proposals.	19
NSF should improve the proposal/reporting mechanism with better templates and processes.	16

NSF should provide more resources (staff, time, training) or limit work (submission limits) for program officers, program directors, and reviewers.	16
NSF should clarify/emphasize the meaning, purpose, and importance of the Broader Impacts criterion.	15
Principal investigators do not have the expertise/time/money for Broader Impacts Activities – Such activities should be left up to institutions/specialists.	13
The relative weights of the potential consideration under each criterion need to be clarified.	12
NSF should require sound technical proposals (prior research, qualifications, design, methodology, evaluation, resources).	12
NSF should better articulate goals/mission of Merit Review criteria.	8
NSF needs to prevent checklist approaches maybe by reducing/simplifying the criteria.	6
NSF should require better linkages between Intellectual Merit and Broader Impacts in projects.	6
NSF should ensure Intellectual Merit/Broader Impacts activities follow the proposed ones.	6

Appendix E: *Survey of Principal Investigators and Reviewers*

Methodology

This survey's sample frame was developed using NSF and National Science Board (NSB) Task Force provided lists of Principal Investigators who had received a decision on a NSF research proposal during CYs 2009 and 2010, individuals who had served as panel reviewers during 2009 or 2010, and individuals who had served as ad hoc reviewers during the same time period. Since individuals could be on more than one list and could appear more than once on the same list, SRI undertook a series of steps to merge the lists and eliminate all obvious duplicates. The resulting list contained 100,509 unique individuals and served as the sampling frame for the survey. A random sample of 8,000 individuals was selected from this frame. Subtracting 187 ineligible individuals who responded that they had neither submitted a proposal nor had reviewed for NSF, the final sample size was 7,813.

This sample was surveyed using a web-based questionnaire. The survey instrument was developed and refined in consultation with the NSB Task Force on Merit Review and pretested with six individuals. Survey invitees received a presurvey email, a survey email invitation, and two reminders from SRI. The preliminary email and the survey invitation included assurances that there would be no individual attribution to any survey respondent and that SRI as the survey administrator would maintain the confidentiality of all respondents. The survey remained open from March 22, 2011 to April 13, 2011. Usable responses were obtained from 3,989 individuals – 971 individuals who indicated they had only submitted a proposal to the NSF; 1,263 individuals who indicated they had only reviewed proposals for the NSF; and 1,755 individuals who had both submitted a proposal to the NSF and had reviewed proposals for the NSF. Overall response rate for the survey was 51%.

Given this survey's sample size, the results are subject to a sampling error of plus or minus 1.56 percentage points at the 95 percent confidence level. This means that in 95 out of 100 samples like the one used here, the results obtained should be no more than 1.56 percentage points above or below the figure obtained if the entire population of Principal Investigators and Reviewers in 2009/2010 had been surveyed accurately. (The statistical error for subgroups of the survey would be higher.) However, in this survey, as in all surveys, there are several other possible sources of error that are probably more serious than that of sampling error. They include but are not limited to non-response and measurement errors such as question wording and question order, and respondent errors. It is difficult or impossible to quantify the errors that may result from these factors.

Survey Instrument

Pages 122-149

NSF 2011 Survey of Principal Investigators and Reviewers

Thank you for participating in our survey.

The National Science Board (NSB) is currently undertaking a review of the two merit review criteria (Intellectual Merit and Broader Impacts). As part of that review, the NSB Task Force on Merit Review has contracted with SRI International to assist in gathering and analyzing input from various stakeholders on a number of issues related to the two criteria. These issues include how the criteria are interpreted by both external communities and internal NSF staff, as well as how the criteria are used in the preparation and review of proposals, and in making funding decisions.

This survey is being sent to a random sample of individuals who submitted proposals to the NSF that were awarded or declined during 2009 and 2010 and/or served as a proposal reviewer during that same period.

Your participation in this survey is voluntary. You may choose not to provide information that you feel is privileged. There will be no individual attribution to any survey response. SRI as the survey administrator will maintain the confidentiality of all respondents. Any survey data provided to anyone outside of SRI, including NSF or the NSB, will be purged of information that could be used to identify individual responses. Please note:

- This survey contains both structured and open-ended questions; it should take about 15 – 30 minutes of your time to complete, depending on your responses to open-ended questions.
- This survey will be open through April 14, 2011.
- When you complete the survey, please click the "SUBMIT" button at the end.
- If you do not complete the entire survey and choose to return to it at a later time, please click the button labeled "RESUME LATER" and follow on-screen directions for saving.
- Please click the button "NEXT" to proceed to the survey.

If you have any technical questions about the web survey, please contact Roland Bardou at NSF_Merit_Review@sri.com, or 703-247-8545. If you have general questions about the study, please contact me at NSF_Merit_Review@sri.com.

Sincerely,
Jongwon Park,
Study Director
SRI International

Pursuant to 5 CFR 1320.5(b), an agency may not conduct or sponsor, and a person is not required to respond to an information collection unless it displays a valid OMB control number. The OMB control number for this collection is 3145-0157. Public reporting burden for this collection of information is estimated to average 15-30 minutes per response, including the time for reviewing instructions. Send comments regarding this burden estimate and any other aspect of this collection of information, including suggestions for reducing this burden, to: Reports Clearance Officer, Facilities and Operations Branch, Division of Administrative Services, National Science Foundation, Arlington, VA 22230.

There are 33 questions in this survey; however, you will automatically be skipped past some questions that do not apply to you.

Principal Investigator – Views on Intellectual Merit and Broader Impacts Criteria

Please do not use the "back" button on your browser. Instead, please click the "Previous" button at the bottom of the page to return to earlier questions.

** indicates a required field*

1 Have you ever submitted a research proposal of any type to NSF? *

Please choose **only one** of the following:

Yes

No

Principal Investigator – Views on Intellectual Merit and Broader Impacts Criteria (cont.)

** indicates a required field*

2 In the past 2 years, have you received a decision on one or more research proposal(s) (of any type) that you submitted to NSF? *

Only answer this question if the following conditions are met:

° Answer was 'Yes' at question '1 [Q1]' (Have you ever submitted a research proposal of any type to NSF?)

Please choose **only one** of the following:

Yes

No

Principal Investigator – Views on Intellectual Merit and Broader Impacts Criteria (cont.)

3 Was your most recent NSF proposal decision an award or a declination?

Only answer this question if the following conditions are met:

° Answer was 'Yes' at question '2 [Q2]' (In the past 2 years, have you received a decision on one or more research proposal(s) (of any type) that you submitted to NSF?)

Please choose **only one** of the following:

- Declination
- Award

4 Do you currently have a proposal that you submitted to NSF under consideration?

Only answer this question if the following conditions are met:

° Answer was 'Yes' at question '2 [Q2]' (In the past 2 years, have you received a decision on one or more research proposal(s) (of any type) that you submitted to NSF?)

Please choose **only one** of the following:

- Yes
- No

Principal Investigator – Views on Intellectual Merit and Broader Impacts Criteria (cont.)

5a In preparing the proposal(s) you submitted to NSF during the past 2 to 3 years, how useful was information you obtained regarding the Intellectual Merit criterion from each of the following sources?

Only answer this question if the following conditions are met:

° Answer was 'Yes' at question '2 [Q2]' (In the past 2 years, have you received a decision on one or more research proposal(s) (of any type) that you submitted to NSF?)

Please choose the appropriate response for each item:

	Did not use	Not at all useful	Somewhat useful	Moderately useful	Very useful
NSF Grant Proposal Guide	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Other NSF Resources available on the web	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Personal contact with NSF official/staff – email, phone, or in person	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
My University/Institution	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Professional Organization/Society	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Peers	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Feedback from NSF on previous proposal(s) I submitted	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Other - Please specify below	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

5b Other sources of information and their usefulness

Only answer this question if the following conditions are met:

° Answer was 'Yes' at question '2 [Q2]' (In the past 2 years, have you received a decision on one or more research proposal(s) (of any type) that you submitted to NSF?)

Please write your answer here:

6a In preparing the proposal(s) you submitted to NSF during the past 2 to 3 years, how useful was information you obtained regarding the Broader Impacts criterion from each of the following sources?

Only answer this question if the following conditions are met:

° Answer was 'Yes' at question '2 [Q2]' (In the past 2 years, have you received a decision on one or more research proposal(s) (of any type) that you submitted to NSF?)

Please choose the appropriate response for each item:

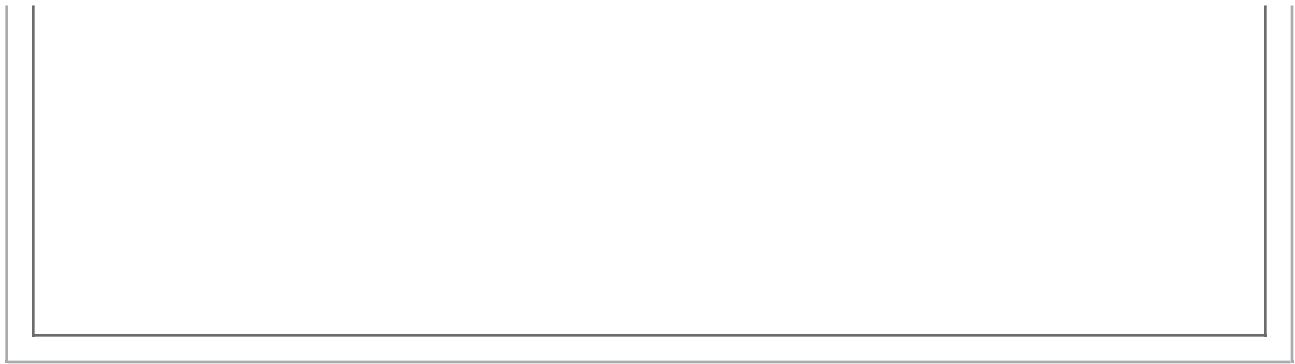
	Did not use	Not at all useful	Somewhat useful	Moderately useful	Very useful
NSF Grant Proposal Guide	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Other NSF resources available on the web	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Personal contact with NSF official/staff – email, phone, or in person	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
My University/Institution	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Professional Organization/Society	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Peers	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Feedback from NSF on previous proposal(s) I submitted	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Other - Please specify below	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

6b Other sources of information and their usefulness

Only answer this question if the following conditions are met:

° Answer was 'Yes' at question '2 [Q2]' (In the past 2 years, have you received a decision on one or more research proposal(s) (of any type) that you submitted to NSF?)

Please write your answer here:



Principal Investigator – Views on Intellectual Merit and Broader Impacts Criteria (cont.)

7 Considering decisions you have received on NSF proposals during the past 2 to 3 years, what portion of those reviewers seem to have a sufficient understanding of each of the two Merit Review criteria?

Only answer this question if the following conditions are met:

° Answer was 'Yes' at question '2 [Q2]' (In the past 2 years, have you received a decision on one or more research proposal(s) (of any type) that you submitted to NSF?)

Please choose the appropriate response for each item:

	All/Almost all understood	Most understood	About half understood	Only some understood	Few/None understood	No basis to judge
Intellectual Merit Criterion	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Broader Impacts Criterion	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

8 Based on your experiences submitting proposals to NSF during the past 2 to 3 years, how much weight did reviewers place on the Intellectual Merit criterion compared to the Broader Impacts criterion in the NSF review process?

Only answer this question if the following conditions are met:

° Answer was 'Yes' at question '2 [Q2]' (In the past 2 years, have you received a decision on one or more research proposal(s) (of any type) that you submitted to NSF?)

Please choose **only one** of the following:

- Much more weight on Intellectual Merit
- Somewhat more weight on Intellectual Merit
- Equal weight on both
- Somewhat more weight on Broader Impacts
- Much more weight on Broader Impacts
- No basis to judge
- Other - Please explain in comment section

Make a comment on your choice here:

9 In your opinion, how much weight should reviewers place on the Intellectual Merit criterion compared to the Broader Impacts criterion when evaluating proposals in subject areas such as yours?

Only answer this question if the following conditions are met:

° Answer was 'Yes' at question '2 [Q2]' (In the past 2 years, have you received a decision on one or more research proposal(s) (of any type) that you submitted to NSF?)

Please choose **only one** of the following:

- Much more weight on Intellectual Merit
- Somewhat more weight on Intellectual Merit
- Equal weight on both
- Somewhat more weight on Broader Impacts
- Much more weight on Broader Impacts
- No basis to judge
- Other - Please explain in the comment section

Make a comment on your choice here:

Principal Investigator – Views on Intellectual Merit and Broader Impacts Criteria (cont.)

10 In your opinion, should your institution play a greater or lesser role than it currently does in providing support to the portion of PIs' proposals designed to satisfy the Intellectual Merit criterion and the Broader Impacts criterion?

Only answer this question if the following conditions are met:

° Answer was 'Yes' at question '2 [Q2]' (In the past 2 years, have you received a decision on one or more research proposal(s) (of any type) that you submitted to NSF?)

Please choose the appropriate response for each item:

	Much greater	Somewhat greater	Stay the same	Somewhat less	Much less	No basis to judge
Intellectual Merit	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Broader Impacts	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

11 What suggestions, if any, do you have for ways your university/institution could do more to support PIs in their efforts to meet the NSF's review criteria of (1) Intellectual Merit, and (2) Broader Impacts criteria?

Only answer this question if the following conditions are met:

° Answer was 'Yes' at question '2 [Q2]' (In the past 2 years, have you received a decision on one or more research proposal(s) (of any type) that you submitted to NSF?)

Please write your answer(s) here:

Support PIs efforts for Intellectual Merit

Support PIs efforts for Broader Impact

Principal Investigator – Views on Intellectual Merit and Broader Impacts Criteria (cont.)

12 To what extent did the Broader Impacts activities in the most recent proposal you submitted to NSF address each of the following?

Only answer this question if the following conditions are met:

° Answer was 'Yes' at question '2 [Q2]' (In the past 2 years, have you received a decision on one or more research proposal(s) (of any type) that you submitted to NSF?)

Please choose the appropriate response for each item:

	Little, or no extent	Some extent	Moderate extent	Great extent	Very great extent	No basis to judge
Increased economic competitiveness of the United States.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Development of a globally competitive STEM (Science, Technology, Engineering, and Mathematics) workforce.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Increased participation of women and underrepresented minorities in STEM.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Increased partnerships between academia and industry.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Improved pre-K–12 STEM education and teacher development.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Improved undergraduate STEM education.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Increased public scientific literacy.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Increased national security.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

13 What portion, if any, of the Broader Impacts activities specified in the most recent proposal you submitted to NSF *went beyond* those activities associated with doing the research and reporting the results to other

researchers?

Only answer this question if the following conditions are met:

° Answer was 'Yes' at question '2 [Q2]' (In the past 2 years, have you received a decision on one or more research proposal(s) (of any type) that you submitted to NSF?)

Please choose **only one** of the following:

- All or almost all
- Most
- About half
- Some
- None
- No basis to judge

14 In the most recent proposal you submitted to NSF did your budget include costs associated with activities that you had identified as related to the Broader Impacts criterion?

Only answer this question if the following conditions are met:

° Answer was 'Yes' at question '2 [Q2]' (In the past 2 years, have you received a decision on one or more research proposal(s) (of any type) that you submitted to NSF?)

Please choose **only one** of the following:

- Yes
- No

Reviewer – Views on Intellectual Merit and Broader Impacts Criteria

** indicates a required field*

15 During the past 2 years have you served as an NSF reviewer on a review panel or as an individual reviewer outside the panel system by mail or email (referred to as an ad hoc reviewer)? *

Please choose **only one** of the following:

- I have served on a review panel only
- I have served as an individual reviewer on ad hoc basis only
- I have served as both panel and ad hoc reviewer
- I have not served as an NSF reviewer

Reviewer – Views on Intellectual Merit and Broader Impacts Criteria (cont.)

16a As a reviewer, how useful was information you obtained regarding the Intellectual Merit criterion from each of the following sources in assessing the proposals you reviewed during the past 2 years?

Only answer this question if the following conditions are met:

° Answer was 'I have served as both panel and ad hoc reviewer' or 'I have served as an individual reviewer on ad hoc basis only' or 'I have served on a review panel only' at question '17 [Q15]' (During the past 2 years have you served as an NSF reviewer on a review panel or as an individual reviewer outside the panel system by mail or email (referred to as an ad hoc reviewer)?)

Please choose the appropriate response for each item:

	Did not use source – Not applicable	Not at all useful	Somewhat useful	Moderately useful	Very useful
NSF Grant Proposal Guide	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Other NSF Resources available on the web	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
NSF Program Officer	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Other NSF Staff	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
My University/Institution	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Professional Organization/Society	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Peers	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Feedback from NSF on proposal(s) I submitted	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Other - Please specify below	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

16b Other sources of information and their usefulness

Only answer this question if the following conditions are met:

° Answer was 'I have served as both panel and ad hoc reviewer' or 'I have served as an individual reviewer on ad hoc basis only' or 'I have served on a review panel only' at question '17 [Q15]' (During the past 2 years have you served as an NSF reviewer on a review panel or as an individual reviewer outside the panel system by mail or email (referred to as an ad hoc reviewer)?)

Please write your answer here:

17a As a reviewer, how useful was information you obtained regarding the Broader Impacts criterion from each of the following sources in assessing the proposals you reviewed during the past 2 years?

Only answer this question if the following conditions are met:

° Answer was 'I have served as both panel and ad hoc reviewer' or 'I have served as an individual reviewer on ad hoc basis only' or 'I have served on a review panel only' at question '17 [Q15]' (During the past 2 years have you served as an NSF reviewer on a review panel or as an individual reviewer outside the panel system by mail or email (referred to as an ad hoc reviewer)?)

Please choose the appropriate response for each item:

	Did not use source – Not applicable	Not at all useful	Somewhat useful	Moderately useful	Very useful
NSF Grant Proposal Guide	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Other NSF resources available on the web	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
NSF Program Officer	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Other NSF staff	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
My University/Institution	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Professional Organization/Society	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Peers	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Feedback from NSF on proposal(s) I submitted	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Other - Please specify below	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

17b Other sources of information and their usefulness

Only answer this question if the following conditions are met:

° Answer was 'I have served on a review panel only' or 'I have served as both panel and ad hoc reviewer' or 'I have served as an individual reviewer on ad hoc basis only' at question '17 [Q15]' (During the past 2 years have you served as an NSF reviewer on a review panel or as an individual reviewer outside the panel system by mail or email (referred to as an ad hoc reviewer)?)

Please write your answer here:

Reviewer – Views on Intellectual Merit and Broader Impacts Criteria (cont.)

18 Based on your experiences as an NSF review panel member during the past 2 years, how much weight did other reviewers typically place on the Intellectual Merit criterion compared to the Broader Impacts criterion?

Only answer this question if the following conditions are met:

° Answer was 'I have served as both panel and ad hoc reviewer' or 'I have served as an individual reviewer on ad hoc basis only' or 'I have served on a review panel only' at question '17 [Q15]' (During the past 2 years have you served as an NSF reviewer on a review panel or as an individual reviewer outside the panel system by mail or email (referred to as an ad hoc reviewer)?)

Please choose **only one** of the following:

- Much more weight on Intellectual Merit
- Somewhat more weight on Intellectual Merit
- Equal weight on both
- Somewhat more weight on Broader Impacts
- Much more weight on Broader Impacts
- No basis to judge
- Other - Please explain in comment section

Make a comment on your choice here:

19 In your opinion, how much weight *should* reviewers place on the Intellectual Merit Criterion compared to the Broader Impacts criterion?

Only answer this question if the following conditions are met:

° Answer was 'I have served as both panel and ad hoc reviewer' or 'I have served as an individual reviewer on ad hoc basis only' or 'I have served on a review panel only' at question '17 [Q15]' (During the past 2 years have you served as an NSF reviewer on a review panel or as an individual reviewer outside the panel system by mail or email (referred to as an ad hoc reviewer)?)

Please choose **only one** of the following:

- Much more weight on Intellectual Merit
- Somewhat more weight on Intellectual Merit
- Equal weight on both
- Somewhat more weight on Broader Impacts
- Much more weight on Broader Impacts
- No basis to judge
- Other - Please explain in comment section

Make a comment on your choice here:

20 How many of the proposals that you reviewed during the past 2 years contained specific Broader Impacts goals and activities that *went beyond* those activities associated with doing the research and reporting the results to other researchers?

Only answer this question if the following conditions are met:

° Answer was 'I have served as both panel and ad hoc reviewer' or 'I have served as an individual reviewer on ad hoc basis only' or 'I have served on a review panel only' at question '17 [Q15]' (During the past 2 years have you served as an NSF reviewer on a review panel or as an individual reviewer outside the panel system by mail or email (referred to as an ad hoc reviewer)?)

Please choose **only one** of the following:

- None
- Some
- About half
- Most
- All or almost all
- Do not recall

21 How many of the proposals that you reviewed during the past 2 years included costs in the budget to support goals or activities the PI had identified as related to Broader Impacts?

Only answer this question if the following conditions are met:

° Answer was 'I have served as an individual reviewer on ad hoc basis only' or 'I have served as both panel and ad hoc reviewer' or 'I have served on a review panel only' at question '17 [Q15]' (During the past 2 years have you served as an NSF reviewer on a review panel or as an individual reviewer outside the panel system by mail or email (referred to as an ad hoc reviewer)?)

Please choose **only one** of the following:

- None
- Some
- About half
- Most
- All or almost all
- Do not recall

Principal Investigator & Reviewer – Views on Intellectual Merit and Broader Impacts Criteria

22 In the Grants Proposal Guide, NSF provides the following list of potential considerations for the Intellectual Merit criterion:

- How important is the proposed activity to advancing knowledge and understanding within its own field or across different fields?
- How well qualified is the proposer (individual or team) to conduct the project? (If appropriate, the reviewer will comment on the quality of prior work.)
- To what extent does the proposed activity suggest and explore creative, original, or potentially transformative concepts?
- How well conceived and organized is the proposed activity?
- Is there sufficient access to resources?

How would you rate this list as guidance for PIs in formulating proposals?-- and for reviewers in assessing proposals?

Please choose the appropriate response for each item:

	Excellent	Good	Fair	Poor	Very poor	No basis to judge
For PIs in formulating proposals	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
For reviewers in assessing proposals	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

23 In the Grants Proposal Guide NSF also provides the following list of potential considerations for the Broader Impacts criterion:

- How well does the activity advance discovery and understanding while promoting teaching, training, and learning?
- How well does the proposed activity broaden the participation of underrepresented groups (such as gender, ethnicity, disability, geographic, etc.)?
- To what extent will it enhance the infrastructure for research and education, such as facilities, instrumentation, networks, and partnerships?
- Will the results be disseminated broadly to enhance scientific and technological understanding?
- What may be the benefits of the proposed activity to society?

How would you rate this list as guidance for PIs in formulating proposals? -- and for reviewers in assessing proposals?

Please choose the appropriate response for each item:

	Excellent	Good	Fair	Poor	Very poor	No basis to judge
For PIs in formulating proposals	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
For reviewers in assessing proposals	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

24 What suggestions, if any, would you offer to improve the guidance NSF provides to PIs and reviewers in Grant Proposal Guide regarding the merit review criteria of (1) Intellectual Merit, and (2) Broader Impacts.

Please write your answer(s) here:

Intellectual Merit

Broader Impacts

Principal Investigator & Reviewer – Views on Intellectual Merit and Broader Impacts Criteria (cont.)

25 In your opinion, should NSF do more or less than it is currently doing to assess whether or not the goals of Intellectual Merit and Broader Impacts were realized in the completed research it funded?

Please choose the appropriate response for each item:

	Much more	Somewhat more	About the same	Somewhat less	Much less	No basis to judge
Intellectual Merit	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Broader Impacts	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Principal Investigator & Reviewer – Views on Intellectual Merit and Broader Impacts Criteria (cont.)

26 If you have any additional comments including suggested improvements to NSF's Merit Review Criteria or related issues, please provide them below.

Please write your answer here:

Background

The following demographic questions are asked for statistical purposes. Your responses are voluntary.

27 What is your Ethnicity?

Please choose **only one** of the following:

- Hispanic or Latino
- Not Hispanic or Latino

28 What is your race?

Please choose **all** that apply:

- American Indian or Alaska Native
- Asian
- Black or African American
- Native Hawaiian or Other Pacific Islander
- White

29 What is your gender?

Please choose **only one** of the following:

- Female
- Male

30 What is your current disability status?

Please choose **all** that apply:

- None
- Hearing impairment not corrected with hearing aid
- Visual impairment not corrected with glasses
- Mobility/Orthopedic impairment
- Other - Please explain:

31 Which of the following best describes your citizenship and current residency status?

Please choose **only one** of the following:

- U.S. citizen
- Non-U.S. citizen with a permanent U.S. resident visa
- Non-U.S. citizen with a temporary U.S. visa
- Non-U.S. citizen

32 Do you currently reside in the U.S.?

Please choose **only one** of the following:

- Yes
- No

33 How many years ago did you receive your highest terminal professional degree?

Please choose **only one** of the following:

- Less than 3 years
- 3 - 5 years
- 5 - 10 years
- 10 - 15 years
- 15 - 20 years
- 20 - 25 years
- 25 - 30 years
- More than 30 years
- Not applicable

Survey Submittal

Thank you for completing the survey. When you are ready to submit your answers, please click on the "Submit" button below.

Please submit by 13.04.2011 – 00:00
Submit your survey.
Thank you for completing this survey.

Results
Frequencies, means, and confidence intervals.

Coding for Means, etc.

NOTE: For a sample size of 4174 and a 50% frequency, the confidence interval would be $\pm 1.52\%$ for a 95% confidence level. Subgroups' confidence intervals will be slightly higher.

Group	Percent	Count
Neither Reviewer or Principal Investigator	4.5%	187
Only Principal Investigator	23.3%	971
Only Reviewer	30.2%	1263
Both Principal Investigator and Reviewer	42.0%	1755
Total Count	4176	4176

These respondents have been removed from all analyses except question 1, 2, and 15.

Respondents who only have submitted a proposal to the NSF in the past two years

Respondents who only have reviewed for the NSF in the past two years

Respondents who have both submitted a proposal to and have reviewed for the NSF in the past two years

Question 1: Have you ever submitted a research proposal of any type to NSF?				
	All	Principal Investigator Only	Reviewer Only	Principal Investigator and Reviewer
1	84.4%	100%	52.1%	100%
0	15.6%		47.9%	
Total Count	4174	971	1261	1755

Question 2: In the past 2 years, have you received a decision on one or more research proposal(s) (of any type) that you submitted to NSF?				
	All	Principal Investigator Only	Reviewer Only	Principal Investigator and Reviewer
1	77.4%	100%		100%
0	22.6%		100%	
Total Count	3522	971	657	1755

Question 3: Was your most recent NSF proposal decision an award or a declination?			
	All	Principal Investigator Only	Principal Investigator and Reviewer
Award	39.5%	30.1%	44.7%
Declination	60.5%	69.9%	55.3%
Total	2717	969	1748

1

0

Question 4: Do you currently have a proposal that you submitted to NSF under consideration?			
	All	Principal Investigator Only	Principal Investigator and Reviewer
Yes	40.8%	36.4%	43.2%
No	59.2%	63.6%	56.8%
Total Count	2718	970	1748

1

0

Question 5: In preparing the proposal(s) you submitted to NSF during the past 2 to 3 years, how useful was information you obtained regarding the Intellectual Merit criterion from each of the following sources?									
Intellectual Merit									
All	NSF Grant Proposal Guide	Other NSF Resources available on the web	Personal contact with NSF official/staff – email, phone, or in person	My University/ Institution	Professional Organization/ Society	Peers	Feedback from NSF on previous proposal(s) I submitted	Other - Please specify below	
Did not use	8.1%	34.0%	33.3%	32.3%	70.3%	16.9%	15.6%	84.4%	
Not at all useful	3.4%	5.6%	7.1%	14.8%	12.1%	2.9%	12.0%	1.1%	
Somewhat useful	26.5%	26.1%	16.9%	22.5%	10.5%	20.9%	23.9%	1.8%	
Moderately useful	34.5%	24.9%	18.7%	19.1%	5.5%	30.2%	24.3%	2.2%	
Very useful	27.6%	9.3%	24.0%	11.4%	1.6%	29.1%	24.2%	10.5%	
Total Count	2710	2674	2698	2672	2666	2645	2692	1530	
MEAN (Std Dev)	2.94 (0.85)	2.58 (0.83)	2.89 (1.01)	2.4 (1.01)	1.89 (0.89)	3.03 (0.86)	2.72 (1.03)	3.41 (0.95)	
Two-sided confidence limit for the mean (95%)	2.91 - 2.97	2.54-2.61	2.85-2.94	2.35-2.45	1.82-1.95	2.99-3.06	2.68-2.76	3.29-3.53	
Principal Investigator Only	NSF Grant Proposal Guide	Other NSF Resources available on the web	Personal contact with NSF official/staff – email, phone, or in person	My University/ Institution	Professional Organization/ Society	Peers	Feedback from NSF on previous proposal(s) I submitted	Other - Please specify below	
Did not use	5.8%	32.5%	39.2%	31.7%	74.2%	15.8%	19.6%	87.9%	
Not at all useful	4.7%	7.1%	10.6%	13.8%	10.5%	3.2%	15.6%	1.4%	
Somewhat useful	25.9%	27.0%	15.8%	22.9%	8.5%	21.7%	25.7%	2.3%	
Moderately useful	35.8%	24.2%	15.8%	19.7%	5.6%	30.2%	19.6%	2.1%	
Very useful	27.8%	9.1%	18.5%	11.9%	1.3%	29.2%	19.4%	6.3%	
Total Count	965	954	960	954	946	945	957	560	
MEAN (Std Dev)	2.92 (0.87)	2.52 (0.86)	2.7 (1.08)	2.44 (1)	1.91 (0.9)	3.01 (0.87)	2.53 (1.06)	3.09 (1.09)	
Two-sided confidence limit for the mean (95%)	2.86 - 2.98	2.46-2.59	2.61-2.78	2.36-2.51	1.8-2.02	2.95-3.07	2.46-2.61	2.82-3.35	

Principal Investigator and Reviewer	NSF Grant Proposal Guide	Other NSF Resources available on the web	Personal contact with NSF official/staff – email, phone, or in person	My University/ Institution	Professional Organization/ Society	Peers	Feedback from NSF on previous proposal(s) I submitted	Other - Please specify below
Did not use	9.3%	34.8%	30.0%	32.6%	68.1%	17.5%	13.4%	82.5%
Not at all useful	2.6%	4.8%	5.2%	15.3%	13.0%	2.8%	10.0%	0.9%
Somewhat useful	26.8%	25.6%	17.5%	22.2%	11.7%	20.5%	22.9%	1.5%
Moderately useful	33.8%	25.3%	20.3%	18.7%	5.4%	30.3%	26.9%	2.2%
Very useful	27.5%	9.4%	27.0%	11.1%	1.8%	29.0%	26.8%	12.9%
Total Counts	1745	1720	1738	1718	1720	1700	1735	970
MEAN (Std Dev)	2.95 (0.84)	2.6 (0.82)	2.99 (0.97)	2.38 (1.01)	1.88 (0.89)	3.04 (0.86)	2.81 (1)	3.54 (0.86)
Two-sided confidence limit for the mean (95%)	2.91 - 2.99	2.56-2.65	2.93-3.04	2.32-2.44	1.8-1.95	2.99-3.08	2.76-2.86	3.41-3.67

For the total number of sources analysis, the sources were counted by adding up the number of times a respondent selected an answer except "did not use"

Question 5 - Total number of sources used	Principal Investigator and Reviewer	
	All	Principal Investigator Only
0	1.0%	0.6%
1	2.1%	2%
2	6.0%	5.8%
3	12.0%	13.8%
4	17.5%	18.3%
5	21.5%	23.58%
6	19.2%	18.74%
7	18.3%	14.9%
8	2.4%	2.16%
9	0%	0%
Total	2726	971
MEAN (Std Dev)	4.9 (1.7)	4.81 (1.64)
Two-sided confidence limit for the mean (95%)	4.84-4.97	4.70-4.91

Broader Impacts

Question 6: In preparing the proposal(s) you submitted to NSF during the past 2 to 3 years, how useful was information you obtained regarding the Broader Impacts criterion from each of the following sources?										
All	NSF Grant Proposal Guide	Other NSF Resources available on the web	Personal contact with NSF official/staff – email, phone, or in person	My University/ Institution	Professional Organization/ Society	Peers	Feedback from NSF on previous proposal(s) I submitted	Other - Please specify below		
Did not use	6.8%	35.4%	43.7%	39.0%	70.0%	18.4%	19.9%	83.3%		
Not at all useful	8.2%	10.0%	9.3%	16.5%	12.7%	4.2%	16.4%	1.7%		
Somewhat useful	34.1%	26.0%	16.8%	21.7%	10.4%	24.3%	24.7%	2.3%		
Moderately useful	30.6%	20.2%	15.5%	15.0%	5.1%	29.3%	22.7%	3.0%		
Very useful	20.2%	8.4%	14.6%	7.7%	1.8%	23.8%	16.3%	9.8%		
Total Count	2707	2676	2684	2665	2650	2642	2676	1466		
MEAN (Std Dev)	2.68 (0.91)	2.42 (0.9)	2.63 (1.04)	2.23 (0.99)	1.87 (0.9)	2.89 (0.88)	2.48 (1.03)	3.24 (1.03)		
Two-sided confidence limit for the mean (95%)	2.64-2.71	2.37-2.46	2.58-2.68	2.18-2.28	1.8-1.93	2.85-2.93	2.44-2.53	3.11-3.38		
Principal Investigator Only	NSF Grant Proposal Guide	Other NSF Resources available on the web	Personal contact with NSF official/staff – email, phone, or in person	My University/ Institution	Professional Organization/ Society	Peers	Feedback from NSF on previous proposal(s) I submitted	Other - Please specify below		
Did not use	5.7%	35.4%	49.6%	39.3%	74.8%	19.0%	25.2%	87.7%		
Not at all useful	10.0%	11.7%	11.0%	14.4%	10.3%	4.8%	18.5%	2.0%		
Somewhat useful	31.4%	25.7%	15.4%	21.2%	8.7%	24.4%	23.1%	2.9%		
Moderately useful	31.7%	19.3%	13.1%	15.7%	4.1%	27.5%	19.6%	2.6%		
Very useful	21.3%	7.8%	10.9%	9.4%	2.1%	24.4%	13.5%	4.8%		
Total Count	963	948	954	951	944	939	955	546		
MEAN (Std Dev)	2.68 (0.94)	2.36 (0.91)	2.47 (1.06)	2.33 (1)	1.92 (0.95)	2.88 (0.91)	2.38 (1.05)	2.82 (1.13)		
Two-sided confidence limit for the mean (95%)	2.62-2.74	2.29-2.43	2.38-2.57	2.25-2.41	1.8-2.05	2.82-2.95	2.3-2.45	2.55-3.1		

Principal Investigator and Reviewer	NSF Grant Proposal Guide	Other NSF Resources available on the web	Personal contact with NSF official/staff – email, phone, or in person	My University/ Institution	Professional Organization/ Society	Peers	Feedback from NSF on previous proposal(s) I submitted	Other - Please specify below
1	Did not use	35.4%	40.5%	38.9%	67.4%	18.1%	16.9%	80.7%
2	Not at all useful	9.1%	8.3%	17.6%	14.1%	3.8%	15.3%	1.5%
3	Somewhat useful	26.1%	17.6%	22.0%	11.3%	24.2%	25.6%	1.8%
4	Moderately useful	20.7%	16.9%	14.7%	5.7%	30.4%	24.4%	3.3%
	Very useful	8.7%	16.7%	6.8%	1.6%	23.5%	17.8%	12.7%
	Total Count	1744	1730	1714	1706	1703	1721	920
	MEAN (Std Dev)	2.67 (0.89)	2.7 (1.02)	2.18 (0.97)	1.84 (0.88)	2.9 (0.87)	2.54 (1.02)	3.4 (0.95)
	Two-sided confidence limit for the mean (95%)	2.63-2.72	2.64-2.77	2.12-2.23	1.77-1.91	2.85-2.94	2.49-2.59	3.26-3.55

Question 6 - Total number of sources used	All	Principal Investigator Only	Principal Investigator and Reviewer
0	1.3%	1.2%	1.3%
1	3.5%	4%	3.2%
2	7.9%	8.7%	7.5%
3	14.5%	16.1%	13.6%
4	19.1%	20.2%	18.5%
5	18.1%	18.7%	17.7%
6	15.4%	16.8%	15.16%
7	17.3%	14.5%	20%
8	2.3%	2.88%	3.0%
9	0%	0%	0%
Total	2726	971	1755
MEAN (Std Dev)	4.67 (1.83)	4.49 (1.8)	4.77 (1.85)
Two-sided confidence limit for the mean (95%)	4.6-4.74	4.37-4.60	4.68-4.85

Question 7: Considering decisions you have received on NSF proposals during the past 2 to 3 years, what portion of those reviewers seem to have a sufficient understanding of each of the two Merit Review criteria?

	All			Principal Investigator Only		Principal Investigator and Reviewer	
	Intellectual Merit criterion	Broader Impacts criterion	Intellectual Merit criterion	Broader Impacts criterion	Intellectual Merit criterion	Broader Impacts criterion	Intellectual Merit criterion
5	All/Almost all understood	25.6%	14.5%	20.2%	14.8%	28.6%	14.3%
4	Most understood	41.9%	37.7%	35.8%	33.4%	45.2%	40.1%
3	About half understood	13.4%	18.7%	15.2%	16.0%	12.4%	20.2%
2	Only some understood	10.0%	15.7%	14.4%	17.5%	7.6%	14.6%
1	Few/None understood	3.6%	5.4%	5.4%	7.0%	2.6%	4.6%
	No basis to judge	5.6%	8.0%	9.1%	11.3%	3.6%	6.1%
	Total Counts	2613	2611	933	935	1680	1676
	MEAN (Std Dev)	3.8 (1.07)	3.44 (1.12)	3.56 (1.17)	3.35 (1.2)	3.93 (0.99)	3.48 (1.08)
	Two-sided confidence limit for the mean (95%)	3.76 - 3.85	3.39 - 3.48	3.48 - 3.64	3.27 - 3.44	3.88 - 3.98	3.43 - 3.53

Question 8: Based on your experiences submitting proposals to NSF during the past 2 to 3 years, how much weight did reviewers place on the Intellectual Merit criterion compared to the Broader Impacts criterion in the NSF review process?				
	All	Principal Investigator Only	Principal Investigator and Reviewer	
7	Much more weight on Intellectual Merit	39.8%	28.9%	45.9%
5.5	Somewhat more weight on Intellectual Merit	28.4%	25.0%	30.3%
4	Equal weight on both	11.2%	15.0%	9.2%
2.5	Somewhat more weight on Broader Impacts	3.8%	6.4%	2.3%
1	Much more weight on Broader Impacts	2.3%	3.9%	1.4%
	No basis to judge	11.3%	17.8%	7.8%
	Other - Please explain in comment section	3.1%	3.0%	3.1%
	Total Counts	2714	963	1751
	MEAN (Std Dev)	5.75 (1.49)	5.3 (1.72)	5.97 (1.31)
	Two-sided confidence limit for the mean (95%)	5.69 - 5.81	5.17 - 5.42	5.91 - 6.04

*scale to match similar question the *Survey of NSF Officials and Advisory Committee Members*

Question 9: In your opinion, how much weight should reviewers place on the Intellectual Merit criterion compared to the Broader Impacts criterion when evaluating proposals in subject areas such as yours?				
	All	Principal Investigator Only	Principal Investigator and Reviewer	
7	Much more weight on Intellectual Merit	37.9%	28.6%	43.0%
5.5	Somewhat more weight on Intellectual Merit	34.9%	33.2%	35.9%
4	Equal weight on both	16.8%	22.6%	13.6%
2.5	Somewhat more weight on Broader Impacts	2.9%	4.7%	1.9%
1	Much more weight on Broader Impacts	1.3%	1.9%	0.9%
	No basis to judge	3.0%	5.7%	1.5%
	Other - Please explain in comment section	3.3%	3.3%	3.3%
	Total Count	2710	964	1746
	MEAN (Std Dev)	5.68 (1.35)	5.35 (1.46)	5.86 (1.26)
	Two-sided confidence limit for the mean (95%)	5.63 - 5.74	5.26 - 5.45	5.8 - 5.92

*scale to match similar question the *Survey of NSF Officials and Advisory Committee Members*

Question 10: In your opinion, should your institution play a greater or lesser role than it currently does in providing support to the portion of PIs' proposals designed to satisfy the Intellectual Merit criterion and the Broader Impacts criterion?						
	All			Principal Investigator Only		Principal Investigator and Reviewer
	Intellectual Merit	Broader Impacts	Intellectual Merit	Intellectual Merit	Broader Impacts	Broader Impacts
5	10.2%	19.9%	10.5%	17.6%	10.0%	21.2%
4	21.7%	31.5%	23.7%	30.7%	20.6%	32.0%
3	53.6%	33.8%	48.7%	34.4%	56.2%	33.4%
2	1.1%	1.3%	1.4%	1.0%	1.0%	1.5%
1	1.2%	1.5%	0.8%	1.1%	1.3%	1.7%
	12.3%	12.0%	14.9%	15.3%	10.8%	10.2%
	2659	2638	942	936	1717	1702
	3.44 (0.76)	3.76 (0.87)	3.49 (0.77)	3.74 (0.84)	3.41 (0.76)	3.77 (0.89)
Two-sided confidence limit for the mean (95%)	3.41 - 3.47	3.73 - 3.8	3.44 - 3.54	3.68 - 3.8	3.38 - 3.45	3.73 - 3.82

Question 12: To what extent did the Broader Impacts activities in the most recent proposal you submitted to NSF address each of the following?

	Increased economic competitiveness of the United States	Development of a globally competitive STEM workforce	Increased participation of women and underrepresented minorities in STEM	Increased partnerships between academia and industry	Improved pre-K-12 STEM education and teacher development	Improved undergraduate STEM education	Increased public scientific literacy	Increased national security
1	46.0%	21.6%	16.8%	52.9%	48.0%	22.0%	32.0%	67.4%
2	16.0%	15.4%	14.5%	13.9%	14.8%	16.3%	18.6%	9.5%
3	15.9%	20.3%	23.0%	13.8%	12.9%	19.2%	20.0%	8.1%
4	10.6%	20.7%	19.5%	9.0%	10.4%	18.7%	14.6%	5.2%
5	7.9%	19.7%	23.1%	7.6%	10.7%	20.7%	11.5%	4.6%
	3.6%	2.4%	3.2%	2.8%	3.2%	3.1%	3.3%	5.2%
Total Count	2692	2684	2698	2681	2681	2680	2676	2675
MEAN (Std Dev)	2.16 (1.34)	3.02 (1.44)	3.18 (1.4)	2.02 (1.33)	2.18 (1.42)	3 (1.46)	2.54 (1.39)	1.63 (1.15)
Two-sided confidence limit for the mean (95%)	2.1 - 2.21	2.96 - 3.07	3.13 - 3.24	1.97 - 2.07	2.13 - 2.24	2.94 - 3.06	2.48 - 2.59	1.58 - 1.67
	Increased economic competitiveness of the United States	Development of a globally competitive STEM workforce	Increased participation of women and underrepresented minorities in STEM	Increased partnerships between academia and industry	Improved pre-K-12 STEM education and teacher development	Improved undergraduate STEM education	Increased public scientific literacy	Increased national security
1	44.2%	24.1%	23.6%	51.3%	51.1%	26.1%	35.5%	68.4%
2	15.1%	14.4%	13.9%	12.4%	13.5%	14.0%	18.2%	8.7%
3	15.3%	18.2%	19.2%	13.7%	10.0%	16.0%	18.8%	8.7%
4	11.7%	20.6%	16.6%	9.6%	10.3%	18.6%	12.5%	4.7%
5	9.2%	19.7%	22.2%	9.5%	10.9%	21.5%	11.2%	4.2%
	4.6%	3.0%	4.5%	3.5%	4.1%	3.8%	3.8%	5.4%
Total Count	950	949	955	948	947	948	950	947
MEAN (Std Dev)	2.23 (1.39)	2.97 (1.47)	3 (1.5)	2.1 (1.4)	2.13 (1.44)	2.95 (1.52)	2.44 (1.39)	1.6 (1.12)
Two-sided confidence limit for the mean (95%)	2.14 - 2.32	2.88 - 3.07	2.9 - 3.1	2.01 - 2.2	2.03 - 2.22	2.85 - 3.05	2.34 - 2.53	1.53 - 1.67

Principal Investigator and Reviewer	Increased economic competitiveness of the United States	Development of a globally competitive STEM workforce	Increased participation of women and underrepresented minorities in STEM	Increased partnerships between academia and industry	Improved pre-K-12 STEM education and teacher development	Improved undergraduate STEM education	Increased public scientific literacy	Increased national security
1 Little, or no extent	46.9%	20.2%	13.1%	53.8%	46.4%	19.7%	30.1%	66.8%
2 Some extent	16.5%	15.9%	14.7%	14.7%	15.5%	17.6%	18.8%	10.0%
3 Moderate extent	16.3%	21.4%	25.1%	13.8%	14.5%	21.0%	20.6%	7.8%
4 Great extent	10.0%	20.8%	21.1%	8.6%	10.4%	18.8%	15.8%	5.5%
5 Very great extent	7.2%	19.6%	23.5%	6.6%	10.6%	20.3%	11.7%	4.8%
No basis to judge	3.0%	2.1%	2.5%	2.4%	2.7%	2.7%	3.0%	5.1%
Total Count	1742	1735	1743	1733	1734	1732	1726	1728
MEAN (Std Dev)	2.12 (1.31)	3.04 (1.41)	3.28 (1.34)	1.97 (1.29)	2.21 (1.41)	3.02 (1.42)	2.59 (1.38)	1.65 (1.16)
Two-sided confidence limit for the mean (95%)	2.05 - 2.18	2.97 - 3.11	3.22 - 3.34	1.91 - 2.03	2.14 - 2.28	2.96 - 3.09	2.52 - 2.66	1.59 - 1.7

Question 13: What portion, if any, of the Broader Impacts activities specified in the most recent proposal you submitted to NSF went beyond those activities associated with doing the research and reporting the results to other researchers?			
	All	Principal Investigator Only	Principal Investigator and Reviewer
5	16.0%	13.3%	17.5%
4	24.1%	24.1%	24.2%
3	18.1%	17.5%	18.4%
2	30.6%	30.2%	30.8%
1	5.9%	7.4%	5.1%
	5.3%	7.5%	4.1%
	2703	960	1743
	3.15 (1.22)	3.06 (1.22)	3.19 (1.22)
	3.1 - 3.19	2.98 - 3.14	3.13 - 3.25

Question 14: In the most recent proposal you submitted to NSF did your budget include costs associated with activities that you had identified as related to the Broader Impacts criterion?			
	All	Principal Investigator Only	Reviewer and Principal Investigator
1	55.9%	52.4%	57.8%
0	44.1%	47.6%	42.2%
	2700	955	1745
	0.56 (0.5)	0.52 (0.5)	0.58 (0.49)
	0.54 - 0.58	0.49 - 0.56	0.55 - 0.6

Question 15			
	All	Reviewer Only	Principal Investigator and Reviewer
0	27.7%	0.0%	0.0%
1	38.2%	66.2%	43.3%
2	17.9%	21.0%	27.5%
3	16.2%	12.8%	29.3%
	4176	1263	1755

Question 16: As a reviewer, how useful was information you obtained regarding the Intellectual Merit criterion from each of the following sources in assessing the proposals you reviewed during the past 2 years?

All	NSF Grant Proposal Guide	Other NSF Resources available on the web	NSF Program Officer	Other NSF Staff	My University/ Institution	Professional Organization/ Society	Peers	Feedback from NSF on previous proposal(s) I submitted	Other - Please specify below
Did not use	15.1%	43.9%	33.8%	70.6%	75.8%	78.8%	42.9%	43.4%	88.4%
Not at all useful	2.9%	5.0%	3.3%	5.4%	9.9%	8.4%	2.9%	5.8%	1.1%
Somewhat useful	25.9%	21.8%	14.0%	8.4%	8.4%	7.6%	21.0%	20.7%	1.8%
Moderately useful	30.2%	19.8%	19.3%	8.3%	4.2%	3.8%	19.9%	18.0%	2.1%
Very useful	25.9%	9.6%	29.6%	7.4%	1.7%	1.4%	13.3%	12.1%	6.6%
Total Count	2992	2941	2954	2881	2925	2925	2928	2937	1795
MEAN (Std Dev)	2.93 (0.86)	2.6 (0.87)	3.14 (0.92)	2.6 (1.05)	1.9 (0.92)	1.91 (0.91)	2.76 (0.87)	2.64 (0.93)	3.23 (1.02)
Two-sided confidence limit for the mean (95%)	2.9 - 2.97	2.56 - 2.65	3.09 - 3.18	2.53 - 2.67	1.83 - 1.97	1.84 - 1.98	2.72 - 2.8	2.6 - 2.69	3.09 - 3.37
Reviewer Only	NSF Grant Proposal Guide	Other NSF Resources available on the web	NSF Program Officer	Other NSF Staff	My University/ Institution	Professional Organization/ Society	Peers	Feedback from NSF on previous proposal(s) I submitted	Other - Please specify below
Did not use	13.8%	46.8%	46.9%	78.0%	79.1%	80.7%	52.0%	66.7%	88.4%
Not at all useful	1.4%	3.0%	1.9%	3.4%	5.8%	5.4%	1.7%	3.6%	0.8%
Somewhat useful	19.6%	18.2%	9.6%	5.4%	7.6%	7.0%	15.5%	10.9%	1.9%
Moderately useful	34.2%	21.4%	15.9%	6.7%	5.3%	5.0%	18.1%	11.3%	2.9%
Very useful	31%	10.6%	25.7%	6.5%	2.2%	1.9%	12.6%	7.5%	6.0%
Total Count	1245	1212	1227	1184	1204	1203	1205	1208	863
MEAN (Std Dev)	3.1 (0.8)	2.75 (0.84)	3.23 (0.87)	2.74 (1.05)	2.18 (0.96)	2.18 (0.95)	2.87 (0.85)	2.68 (0.94)	3.22 (0.96)
Two-sided confidence limit for the mean (95%)	3.05 - 3.15	2.68 - 2.81	3.17 - 3.3	2.61 - 2.87	2.06 - 2.3	2.05 - 2.3	2.8 - 2.94	2.58 - 2.77	3.03 - 3.41

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Principal Investigator and Reviewer	NSF Grant Proposal Guide	Other NSF Resources available on the web	NSF Program Officer	Other NSF Staff	My University/ Institution	Professional Organization/ Society	Peers	Feedback from NSF on previous proposal(s) I submitted	Other - Please specify below
Did not use	16.0%	41.8%	24.4%	65.4%	73.6%	77.5%	36.4%	27.2%	88.4%
Not at all useful	4.0%	6.4%	4.3%	6.8%	12.8%	10.5%	3.8%	7.3%	1.3%
Somewhat useful	30.4%	24.2%	17.2%	10.5%	8.9%	8.0%	24.8%	27.5%	1.8%
Moderately useful	27.4%	18.7%	21.8%	9.4%	3.4%	3.0%	21.2%	22.7%	1.4%
Very useful	22.3%	8.8%	32.4%	8.0%	1.3%	1.0%	13.8%	15.3%	7.1%
Total Count	1747	1729	1727	1697	1721	1722	1723	1729	932
MEAN (Std Dev)	2.81 (0.88)	2.51 (0.88)	3.09 (0.94)	2.53 (1.05)	1.74 (0.87)	1.75 (0.85)	2.71 (0.87)	2.63 (0.92)	3.23 (1.08)
Two-sided confidence limit for the mean (95%)	2.76 - 2.85	2.46 - 2.57	3.04 - 3.14	2.45 - 2.62	1.66 - 1.82	1.67 - 1.84	2.66 - 2.76	2.58 - 2.68	3.03 - 3.44

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Question 16 - Total number of sources used	All	Reviewer Only	Principal Investigator and Reviewer
0	3.0%	3.0%	3.0%
1	11.5%	18.1%	6.7%
2	14.9%	18.5%	12.4%
3	17.6%	20.6%	15.5%
4	17.5%	16.9%	17.8%
5	12.3%	7.6%	15.6%
6	6.9%	4.8%	8.4%
7	5.1%	3.4%	6.3%
8	9.7%	5.6%	12.6%
9	1.6%	1.5%	1.7%
Total	3018	1263	1755
MEAN (Std Dev)	3.94 (2.26)	3.33 (2.11)	4.38 (2.26)
Two-sided confidence limit for the mean (95%)	3.86-4.02	3.22-3.45	4.27-4.48

Question 17: As a reviewer, how useful was information you obtained regarding the Broader Impacts criterion from each of the following sources in assessing the proposals you reviewed during the past 2 years?

All	NSF Grant Proposal Guide	Other NSF Resources available on the web	NSF Program Officer	Other NSF Staff	My University/Institution	Professional Organization/Society	Peers	Feedback from NSF on previous proposal(s) I submitted	Other - Please specify below
1	13.1%	44.6%	36.4%	73.1%	74.8%	78.8%	45.2%	46.4%	89.7%
2	4.8%	5.9%	4.8%	6.0%	10.5%	8.5%	4.2%	7.6%	1.9%
3	30.1%	21.9%	15.5%	7.7%	9.0%	7.8%	22.1%	19.8%	2.2%
4	28.6%	18.4%	18.3%	7.4%	4.0%	3.5%	18.1%	16.0%	2.0%
	23.4%	9.3%	25.1%	5.7%	1.7%	1.3%	10.4%	10.2%	4.2%
Total	2975	2926	2931	2869	2902	2906	2912	2907	1823
MEAN (Std Dev)	2.81 (0.89)	2.56 (0.89)	3 (0.97)	2.47 (1.06)	1.88 (0.91)	1.89 (0.9)	2.63 (0.87)	2.54 (0.95)	2.81 (1.16)
Two-sided confidence limit for the mean (95%)	2.78 - 2.85	2.52 - 2.6	2.96 - 3.04	2.4 - 2.55	1.81 - 1.94	1.82 - 1.96	2.59 - 2.67	2.49 - 2.58	2.65 - 2.98
Reviewer Only	NSF Grant Proposal Guide	Other NSF Resources available on the web	NSF Program Officer	Other NSF Staff	My University/Institution	Professional Organization/Society	Peers	Feedback from NSF on previous proposal(s) I submitted	Other - Please specify below
1	12.5%	48.5%	48.7%	79.4%	79.0%	81.0%	53.6%	69.0%	91.3%
2	3.6%	5.0%	3.1%	4.3%	7.2%	6.0%	3.3%	5.3%	2.2%
3	24.5%	16.6%	11.5%	5.2%	7.4%	6.6%	17.7%	10.6%	1.6%
4	32.5%	19.5%	15.4%	6.0%	4.7%	4.8%	15.6%	9.3%	1.6%
Total	1236	1203	1207	1177	1188	1191	1195	1184	860
MEAN (Std Dev)	2.94 (0.87)	2.69 (0.9)	3.07 (0.94)	2.58 (1.08)	2.04 (0.94)	2.11 (0.95)	2.68 (0.88)	2.5 (0.98)	2.68 (1.22)
Two-sided confidence limit for the mean (95%)	2.89 - 2.99	2.61 - 2.76	3 - 3.14	2.44 - 2.71	1.93 - 2.16	1.98 - 2.23	2.61 - 2.76	2.4 - 2.6	2.4 - 2.96

Principal Investigator and Reviewer	NSF Grant Proposal Guide	Other NSF Resources available on the web	NSF Program Officer	Other NSF Staff	My University/ Institution	Professional Organization/ Society	Peers	Feedback from NSF on previous proposal(s) I submitted	Other - Please specify below
Did not use	13.5%	41.8%	27.7%	68.8%	71.8%	77.3%	39.3%	30.9%	88.3%
Not at all useful	5.6%	6.5%	6.0%	7.2%	12.9%	10.3%	4.8%	9.1%	1.7%
Somewhat useful	34.1%	25.5%	18.3%	9.5%	10.1%	8.7%	25.2%	26.2%	2.8%
Moderately useful	25.8%	17.6%	20.3%	8.4%	3.4%	2.6%	19.8%	20.6%	2.3%
Very useful	21.0%	8.5%	27.7%	6.1%	1.8%	1.2%	10.8%	13.2%	5.0%
Total	1739	1723	1724	1692	1714	1715	1717	1723	963
MEAN (Std Dev)	2.72 (0.9)	2.48 (0.87)	2.97 (0.98)	2.43 (1.05)	1.79 (0.89)	1.77 (0.85)	2.6 (0.87)	2.55 (0.95)	2.9 (1.11)
Two-sided confidence limit for the mean (95%)	2.67 - 2.77	2.43 - 2.54	2.91 - 3.02	2.34 - 2.52	1.71 - 1.87	1.68 - 1.85	2.55 - 2.66	2.5 - 2.6	2.7 - 3.11

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Question 17 - Total number of sources used	All	Reviewer Only	Principal Investigator and Reviewer
0	3.1%	3.0%	3.0%
1	13.0%	21%	7.3%
2	16.6%	19.8%	14.3%
3	18.2%	20.0%	16.9%
4	15.5%	14.0%	16.5%
5	11.2%	7.8%	13.6%
6	5.9%	3.4%	7.8%
7	4.7%	3.3%	5.7%
8	9.6%	5.7%	12.4%
9	2.2%	1.8%	2.5%
Total	3018	1263	1755
MEAN (Std Dev)	3.84 (2.31)	3.22 (2.16)	4.28 (2.32)
Two-sided confidence limit for the mean (95%)	3.75-3.92	3.10-3.34	4.17-4.39

Question 18: Based on your experiences as an NSF review panel member during the past 2 years, how much weight did other reviewers typically place on the Intellectual Merit criterion compared to the Broader Impacts criterion?				
	All	Reviewer Only	Principal Investigator and Reviewer	
7	Much more weight on Intellectual Merit	32.2%	23.0%	38.6%
5.5	Somewhat more weight on Intellectual Merit	22.6%	19.5%	24.8%
4	Equal weight on both	7.9%	8.2%	7.6%
2.5	Somewhat more weight on Broader Impacts	2.1%	2.5%	1.8%
1	Much more weight on Broader Impacts	0.7%	0.4%	0.9%
	No basis to judge	29.8%	40.5%	22.3%
	Other - Please explain in comment section	4.8%	6.0%	3.9%
	Total Count	2852	1172	1680
	MEAN (Std Dev)	5.91 (1.31)	5.74 (1.35)	6 (1.28)
	Two-sided confidence limit for the mean (95%)	5.85 - 5.97	5.63 - 5.85	5.93 - 6.07

Question 19: In your opinion, how much weight should reviewers place on the Intellectual Merit criterion compared to the Broader Impacts criterion?				
	All	Reviewer Only	Principal Investigator and Reviewer	
7	Much more weight on Intellectual Merit	38.8%	36.9%	40.3%
5.5	Somewhat more weight on Intellectual Merit	37.6%	35.2%	39.3%
4	Equal weight on both	15.3%	17.6%	13.7%
2.5	Somewhat more weight on Broader Impacts	2.2%	3.1%	1.6%
1	Much more weight on Broader Impacts	1.1%	1.6%	0.7%
	No basis to judge	2.4%	3.5%	1.6%
	Other - Please explain in comment section	2.6%	2.2%	2.9%
	Total Count	2990	1251	1739
	MEAN (Std Dev)	5.75 (1.29)	5.63 (1.39)	5.83 (1.21)
	Two-sided confidence limit for the mean (95%)	5.7 - 5.8	5.55 - 5.71	5.77 - 5.89

Question 20: How many of the proposals that you reviewed during the past 2 years contained specific Broader Impacts goals and activities that went beyond those activities associated with doing the research and reporting the results to other researchers?			
	All	Reviewer Only	Principal Investigator and Reviewer
All or almost all	13.4%	17.1%	10.7%
Most	19.9%	17.0%	22.0%
About half	12.6%	8.7%	15.5%
Some	35.5%	30.6%	39.1%
None	8.7%	12.2%	6.2%
Do not recall	9.9%	14.4%	6.6%
Total Count	2983	1250	1733
MEAN (Std Dev)	2.93 (1.26)	2.96 (1.39)	2.91 (1.17)
Two-sided confidence limit for the mean (95%)	2.88 - 2.98	2.87 - 3.04	2.86 - 2.97

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4
3
2
1

Question 21: How many of the proposals that you reviewed during the past 2 years included costs in the budget to support goals or activities the PI had identified as related to Broader Impacts?			
	All	Reviewer Only	Principal Investigator and Reviewer
All or almost all	6.2%	9.3%	4.0%
Most	8.6%	8.2%	8.8%
About half	7.1%	5.5%	8.3%
Some	40.7%	31.7%	47.2%
None	17.8%	21.3%	15.3%
Do not recall	19.6%	24.0%	16.4%
Total Count	2998	1254	1744
MEAN (Std Dev)	2.31 (1.16)	2.37 (1.32)	2.27 (1.03)
Two-sided confidence limit for the mean (95%)	2.27 - 2.36	2.29 - 2.46	2.22 - 2.32

5
4
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1

Question 22: How would you rate this list as guidance on Intellectual Merit criterion: for PIs in formulating proposals?-- and for reviewers in assessing proposals?									
	All		Principal Investigator Only		Reviewer Only		Principal Investigator and Reviewer		
	PIs	Reviewers	PIs	Reviewers	PIs	Reviewers	PIs	Reviewers	Reviewers
5	32.2%	32.2%	25.2%	21.8%	36.9%	38.4%	32.6%		33.4%
4	50.1%	48.9%	52.0%	45.8%	48.3%	49.9%	50.3%		49.8%
3	12.9%	12.8%	17.3%	18.3%	8.9%	8.5%	13.4%		12.8%
2	2.3%	2.6%	3.1%	4.2%	1.5%	1.5%	2.5%		2.6%
1	0.5%	0.6%	0.9%	1.2%	0.1%	0.2%	0.6%		0.6%
	2.0%	2.9%	1.5%	8.7%	4.2%	1.4%	0.6%		0.7%
Total Count	3942	3935	958	944	1237	1254	1747		1737
MEAN (Std Dev)	4.13 (0.76)	4.13 (0.78)	3.99 (0.8)	3.91 (0.86)	4.26 (0.7)	4.26 (0.7)	4.13 (0.77)		4.14 (0.78)
Two-sided confidence limit for the mean (95%)	4.11 - 4.16	4.1 - 4.15	3.94 - 4.04	3.85 - 3.96	4.22 - 4.3	4.23 - 4.3	4.09 - 4.16		4.1 - 4.17

Question 23: How would you rate this list as guidance on the Broader Impacts criterion: for PIs in formulating proposals?-- and for reviewers in assessing proposals?									
	All		Principal Investigator Only		Reviewer Only		Principal Investigator and Reviewer		
	PIs	Reviewers	PIs	Reviewers	PIs	Reviewers	PIs	Reviewers	Reviewers
5	19.8%	19.1%	15.3%	13.2%	21.9%	22.0%	20.6%		20.3%
4	43.9%	43.9%	43.9%	39.3%	43.1%	46.0%	44.3%		44.9%
3	25.2%	23.9%	28.7%	26.9%	23.0%	21.1%	24.7%		24.3%
2	7.2%	7.6%	8.5%	10.1%	5.8%	6.5%	7.5%		7.1%
1	1.7%	2.2%	2.2%	2.2%	1.1%	1.9%	2.0%		2.3%
	2.3%	3.3%	1.4%	8.4%	5.1%	2.5%	0.9%		1.1%
Total Counts	3928	3917	958	942	1231	1247	1739		1728
MEAN (Std Dev)	3.74 (0.92)	3.73 (0.94)	3.63 (0.92)	3.56 (0.95)	3.83 (0.89)	3.82 (0.92)	3.75 (0.93)		3.74 (0.94)
Two-sided confidence limit for the mean (95%)	3.70 - 3.76	3.7 - 3.76	3.57 - 3.69	3.49 - 3.62	3.78 - 3.88	3.76 - 3.87	3.7 - 3.79		3.7 - 3.79

Question 25: In your opinion, should NSF do more or less than it is currently doing to assess whether or not the goals of Intellectual Merit and Broader Impacts were realized in the completed research it funded?											
	All			Principal Investigator Only			Reviewer Only			Principal Investigator and Reviewer	
	Intellectual Merit	Broader Impacts	Intellectual Merit	Broader Impacts	Intellectual Merit	Broader Impacts	Intellectual Merit	Broader Impacts	Intellectual Merit	Broader Impacts	
5	9.5%	11.3%	12.3%	12.7%	8.6%	11.0%	8.7%	10.8%			
4	23.1%	21.6%	22.3%	20.2%	24.3%	20.4%	22.6%	23.2%			
3	49.7%	37.3%	43.6%	34.3%	43.9%	31.5%	57.2%	43.1%			
2	1.8%	8.0%	3.0%	8.2%	0.9%	9.3%	1.8%	6.9%			
1	0.7%	5.4%	0.8%	5.2%	0.2%	4.6%	1.0%	6.1%			
	15.3%	16.4%	18.0%	19.4%	22.2%	23.1%	8.8%	9.9%			
	3960	3953	962	960	1251	1249	1747	1744			
	MEAN (Std Dev)	3.3 (1.03)	3.51 (0.83)	3.33 (1.06)	3.52 (0.71)	3.31 (1.05)	3.4 (0.73)	3.29 (1)			
	Two-sided confidence limit for the mean (95%)	3.43 - 3.49	3.46 - 3.57	3.26 - 3.41	3.47 - 3.56	3.24 - 3.38	3.36 - 3.43	3.24 - 3.34			

Demographics

Q27: What is your ethnicity?	All	Principal Investigator Only	Reviewer Only	Principal Investigator and Reviewer
Hispanic or Latino	4.4%	5.2%	3.7%	4.6%
Not Hispanic or Latino	95.6%	94.8%	96.3%	95.4%
Total Count	3658	887	1169	1602

Q28: What is your race? (Could choose more than 1)	All		Principal Investigator Only		Reviewer Only		Principal Investigator and Reviewer	
	Count	Percentage	Count	Percentage	Count	Percentage	Count	Percentage
American Indian or Alaska Native	13	0.4%	4	0.5%	2	0.2%	7	0.4%
Asian	502	14.0%	153	17.8%	127	11.0%	222	14.1%
Black or African American	88	2.3%	27	3.1%	19	1.7%	36	2.3%
Native Hawaiian or Other Pacific Islander	3	0.1%	1	0.1%	2	0.2%	0	0%
White	2947	82.1%	661	76.9%	996	86.3%	1290	81.8%
Multiple Responses	44	1.2%	22	1.4%	8	0.7%	22	1.4%
Total Number of Respondents	3591	100%	877	100%	1162	100%	1601	100%

Question 29: What is your gender?	All		Principal Investigator Only	Reviewer Only	Principal Investigator and Reviewer
	Count	Percentage	Count	Percentage	Count
Female	278	27.8%	28.1%	27.9%	27.5%
Male	722	72.2%	71.9%	72.1%	72.5%
Total Count	3677	100%	891	1177	1609

Question 30: What is your current disability status? (could choose more than 1)	All		Principal Investigator Only		Reviewer Only		Principal Investigator and Reviewer	
	Count	Percentage	Count	Percentage	Count	Percentage	Count	Percentage
None	3523	97.1%	861	97.7%	1120	96.3%	1542	97.2%
Hearing impairment not corrected with hearing aid	26	0.7%	3	0.3%	12	1.0%	11	0.7%
Visual impairment not corrected with glasses	11	0.3%	3	0.3%	5	0.4%	3	0.2%
Mobility/Orthopedic impairment	36	1.0%	5	0.5%	11	0.9%	11	0.7%
Other	27	0.9%	5	0.5%	11	0.9%	11	0.7%
Multiple Responses	7	1.9%	0	0%	2	0.2%	5	0.3%
Total Number of Respondents	3637	100%	881	100%	1164	100%	1592	100%

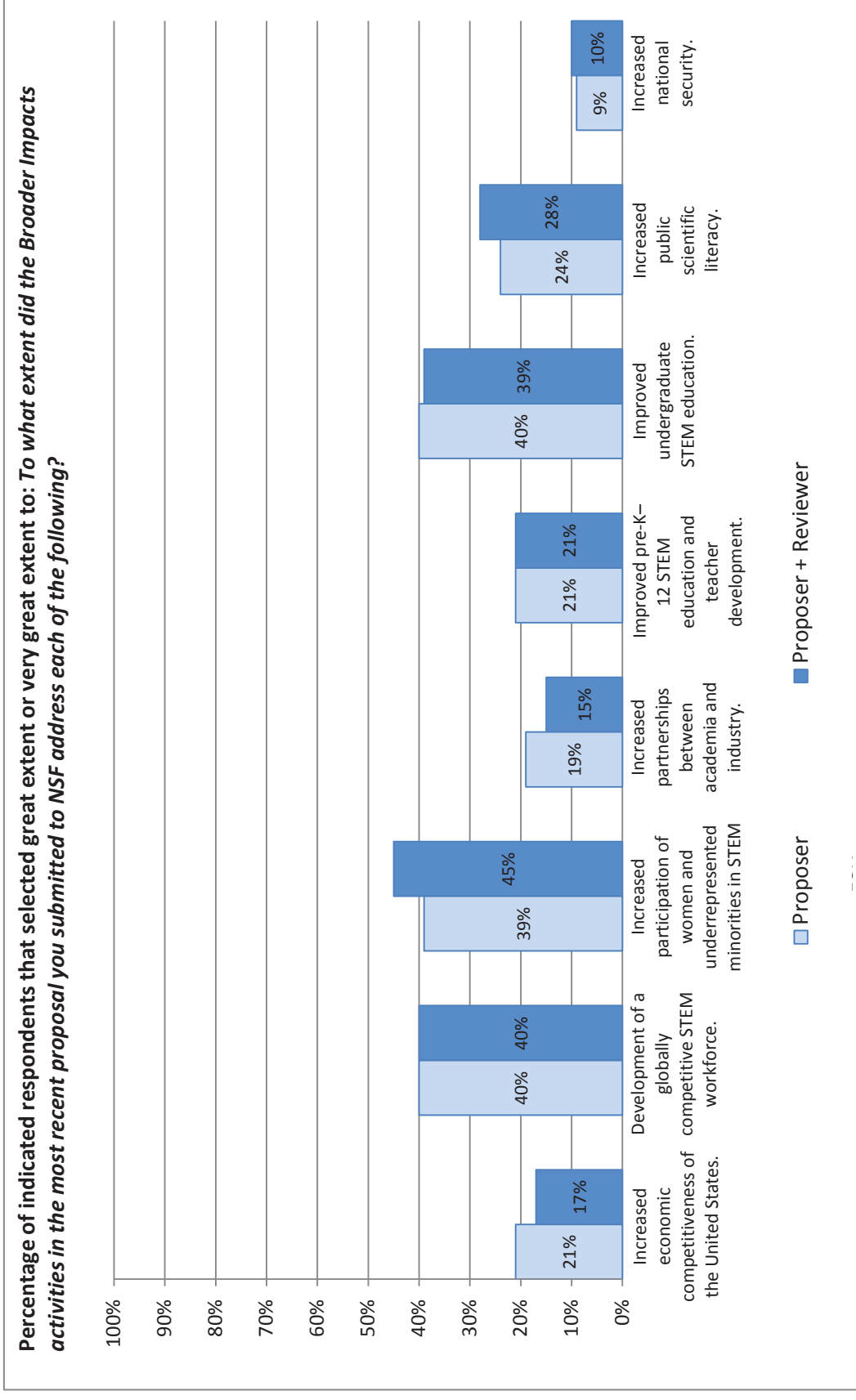
Question 31	All	Principal Investigator Only	Reviewer Only	Principal Investigator and Reviewer
Non-U.S. citizen	8.1%	0.7%	23.5%	0.7%
Non-U.S. citizen with a permanent U.S. resident visa	12.3%	17.3%	7.3%	13.3%
Non-U.S. citizen with a temporary U.S. visa	2.3%	2.7%	2.5%	2.0%
U.S. citizen	77.3%	79.3%	66.6%	84.0%
Total Count	3734	905	1202	1627

Question 32: Do you currently reside in the U.S.?	All	Principal Investigator Only	Reviewer Only	Principal Investigator and Reviewer
Yes	88.3%	97.6%	71.2%	96.2%
No	11.7%	3.4%	28.8%	3.8%
Total Count	3682	891	1185	1607

Q33: Time since terminal degree:				
Q33	All	Principal Investigator Only	Reviewer Only	Principal Investigator and Reviewer
Less than 3 years	4.1%	9.5%	2.8%	2.2%
3 - 5 years	5.9%	8.8%	4.6%	5.3%
5 - 10 years	16.6%	20.8%	11.7%	17.9%
10 - 15 years	17.7%	17.7%	18.1%	17.4%
15 - 20 years	13.5%	10.3%	13.4%	15.2%
20 - 25 years	13.6%	9.1%	14.8%	15.3%
25 - 30 years	11.1%	9.9%	12.0%	11.0%
More than 30 years	17.1%	13.0%	22.4%	15.5%
Not applicable	0.3%	0.9%	0.2%	0.1%
Total Count	3761	909	1205	1647

Expanded Analysis

Question 12: To what extent did the Broader Impacts activities in the most recent proposal you submitted to NSF address each of the following?



Analysis of Open-ended Questions

Institutional Support

In question 11, respondents were asked: What suggestions, if any, do you have for ways your university/institution could do more to support PIs in their efforts to meet the NSF's review criteria of **Intellectual Merit** criterion? 658 suggestions were made. Themes are summarized in Table 1. (Multiple themes were found in responses, so the total theme count is larger than the total count of responses. More than 1,000 responses were recorded; however, only 658 contained actual suggestions. Those themes are reflected below. All themes are included (none had less than five responses)).

Table 1. What suggestions, if any, do you have for ways your university/institution could do more to support PIs in their efforts to meet the NSF's review criteria of **Intellectual Merit** criterion?

Theme	Frequency (of 658)
Institutions could hire/develop qualified, knowledgeable and discipline-specific staff in grant offices or establish a grants office if none already.	161
Institutions could provide pre-submission review and feedback on proposals.	104
Institutions could coordinate proposal-writing mentoring programs.	96
Institutions could organize workshops, training, and seminars on Intellectual Merit and grant writing.	83
Institutions could provide examples and sample documents of local successful proposals.	77
Institutions could provide and raise awareness of infrastructural support (equipment, labs, library services, data management, and administrative support).	66
Institutions could provide guidance on NSF's technical requirements for submission.	52
Institutions could organize seminars with NSF staff to train both principal investigators and staff in grants offices.	52
Institution could provide matching and/or additional funds for postdoctoral fellows, co-principal investigators, equipment, travel, etc.	50
Institutions could provide education and guidance on the substance of the Intellectual Merit criterion.	49
Institutions could reduce teaching loads or offer teaching release.	45
Institutions could provide support and/or seed grants to develop preliminary results.	37
Institutions could promote collaboration between departments and institutions.	28
Institutions could reduce bureaucracy in the proposal review process.	20
Institutions could provide financial and training support for interns, students, and postdoctoral fellows to assist principal investigators.	17
Institutions could reallocate some of the indirect/overhead costs to principal investigator research efforts.	15

Institutions could assist in cost analysis and budgeting for research proposals.	12
Institutions could reward principal investigators/departments with successful NSF proposals.	12
Institutions could lower the overhead rate.	7

In question 11, respondents were also asked: “What suggestions, if any, do you have for ways your university/institution could do more to support PIs in their efforts to meet the NSF’s review criteria of **Broader Impacts** criterion?” 936 suggestions were made. Themes are summarized in Table 2. (Multiple themes were found in responses, so the total theme count is larger than the total count of responses. More than 1,000 responses were recorded; however, only 936 contained actual suggestions. Those themes are reflected below. All themes are included (none had less than four responses)).

Table 2. *What suggestions, if any, do you have for ways your university/institution could do more to support PIs in their efforts to meet the NSF’s review criteria of **Broader Impacts** criterion?*

Themes	Frequency (of 936)
Institutions could develop, create, coordinate, and publicize institutional or other programs and partnerships for Broader Impacts activity opportunities.	319
Institutions could provide well-trained staff to help proposers plan and write-up Broader Impacts activities.	267
Institutions could provide general support for Broader Impacts Activities	137
Institutions could coordinate mentoring both on a peer level and an expert level for Broader Impacts activities.	137
Institutions could provide examples, sample documents, and best practices of successful and unsuccessful Broader Impacts activities.	109
Institutions could promote collaboration among principal investigators, departments, institutions and communities.	68
Institutions could conduct an internal review of proposals to ensure compliance with all requirements and provide informative feedback.	52
Institutions could reduce principal investigator’s work load to enable more time for Broader Impacts activities.	51
Institutions could provide guidance on integrating Broader Impacts activities with research projects.	50
Institutions could provide seed, continuing, matching, or additional funds for Broader Impacts activities, postdoctoral fellows, equipment, travel, etc.	41
Institutions could provide rewards to principal investigators with successful Broader Impacts activities (tenure, promotion) and/or could acknowledge Broader Impacts proposal efforts.	34
Institutions could improve communication with NSF to clarify expectations, etc.	28

Institutions could take primary responsibility for Broader Impacts activities.	26
Institutions could return some of the indirect/overhead costs to principal investigators and/or institute other cost-sharing mechanisms.	14
Institutions could share responsibility for Broader Impacts activities with the principal investigator.	14
Institutions could issue institution-wide Broader Impacts missions, goals, and strategies and provide statements of support in proposals.	11
Institutions could assist in cost analysis and budgeting for proposals on Broader Impacts activities.	10
Institutions could simplify and reduce bureaucracy in the review process.	9
Institutions could lower the overhead rate.	4

Improving Guidance

Question 24 asked respondents: “What suggestions, if any, would you offer to improve the guidance NSF provides to PIs and reviewers in Grant Proposal Guide regarding the merit review criterion of Intellectual Merit?” 694 suggestions were made. Themes are summarized in Table 3. (Multiple themes were found in responses, so the total theme count is larger than the total count of responses. More than 1,000 responses were recorded; however, only 694 contained actual suggestions. Those themes are reflected below. All themes are included (none had less than four responses)).

Table 3. *What suggestions, if any, would you offer to improve the guidance NSF provides to PIs and reviewers in Grant Proposal Guide regarding the merit review criterion of Intellectual Merit?*

Themes	Frequency (of 694)
Guidance should clarify the definition, importance, and expectations for each Intellectual Merit criterion potential consideration and the use of the considerations as a check list.	125
Guidance should provide examples and best practices of proposals with strong/weak Intellectual Merit activities.	86
Guidance should provide more structure for reviewers, and reviewers should be held accountable for reading and following the guidance.	84
Guidance should clarify what constitutes transformative research – definition is vague and broadly interpreted.	68
Guidance should ensure organized and well-conceived proposals with clear objectives, definitions, methodology, and evaluation.	53
Guidance should clarify what, if any, flexibility exists in the application of the Intellectual Merit criterion for difference disciplines, institutions, and proposal types.	48
Guidance should emphasize importance of transformative research.	46
Guidance should clarify the difference and relative weights between the Intellectual Merit criterion and the Broader Impacts criterion.	43

Guidance should reduce emphasis on sufficient access to resources – it is difficult to judge and/or biased against smaller institutions/new principal investigators.	42
Guidance should emphasize the importance of the research itself.	40
Guidance should reduce/eliminate emphasis on transformative research – it is difficult to judge and/or biased against incremental work.	39
Guidance should clearly define what qualifies as “proposer qualifications” and how it should be considered.	38
Guidance should emphasize/clarify sufficient access to resources and feasibility of proposed Intellectual Merit (time, risk, budget, and preliminary data).	38
Guidance should reduce emphasis on the quality of prior research and principal investigator qualifications – creates bias against new principal investigators.	26
NSF should simplify/consolidate the guidelines in general.	22
Guidance should encourage principal investigators to present better linkages between their Intellectual Merit activities and their Broader Impacts activities.	22
Guidance should require literature reviews to show principal investigator understanding of prior knowledge and best practices.	21
Guidance should require shorter, more succinct proposals.	13
Guidance should provide links to training resources.	9
Guidance should delineate a clear a quantitative review process of proposals and reports including scoring/ranking details.	8
Guidance should delineate a clear resubmission process where prior reviewer’s comments are given to future reviewer.	5

Question 24 asked respondents: “What suggestions, if any, would you offer to improve the guidance NSF provides to PIs and reviewers in Grant Proposal Guide regarding the merit review criterion of Broader Impacts?” 940 suggestions were made. Themes are summarized in Table 3. (Multiple themes were found in responses, so the total theme count is larger than the total count of responses. More than 1,000 responses were recorded; however, only 940 contained actual suggestions. Those themes are reflected below. All themes are included.

Table 4. *What suggestions, if any, would you offer to improve the guidance NSF provides to PIs and reviewers in Grant Proposal Guide regarding the merit review criterion of Broader Impacts?*

Theme	Frequency (of 940)
Guidance should provide specific examples of proposals with strong or weak Broader Impacts statements.	213
Guidance should clarify the definition, importance, and expectations for the Broader Impacts criterion.	167

Guidance should address the application of the Broader Impacts criterion to different types of proposals (SBIR, social science, high-risk, etc.).	118
Guidance should instruct reviewers to take Broader Impacts seriously and provide consistent, fair reviews.	80
Guidance should clarify if all the Broader Impacts potential considerations must be addressed.	78
Guidance should emphasize/clarify societal benefits.	77
Guidance should clarify that Broader Impacts is not as important as Intellectual Merit.	74
Guidance should emphasize/clarify advancement of knowledge and STEM education/training.	70
Guidance should discourage “lip-service” answers.	69
Guidance should clarify the of each potential consideration under the Broader Impacts criterion.	67
Guidance should expand the Broader Impacts topics to include commercialization, policy, environment, etc.	63
Guidance should clarify the difference and relative weights between the Intellectual Merit criterion and the Broader Impacts criterion.	52
Guidance should emphasize/clarify broad dissemination of research findings.	49
Guidance should ensure organized and well-conceived proposals w/ clear objectives, definitions, budget, methodology, and evaluation.	46
Guidance should clarify that Broader Impacts activities must go beyond principal investigator's normal activities/audience.	42
Guidance should reduce emphasis on participation of underrepresented groups.	38
Guidance should emphasize/clarify/expand broadening participation of underrepresented groups.	36
Guidance should emphasize feasibility and long-term sustainability of the proposed Broader Impacts and ensure sufficient resources to complete Broader Impacts.	34
Guidance should separate the review process for Intellectual Merit vs. Broader Impacts.	32
Guidance should clarify that Broader Impacts activities do not have to be innovative; PIs already do most Broader Impacts activities as part of their job.	31
Guidance should encourage aggregation of Broader Impacts activities.	30
Guidance should direct principal investigators to integrate Broader Impacts activities with their Intellectual Merit activities.	29
Improve guidance by simplifying guidelines by better delineating or consolidating bullets.	26
Guidance should institute a minimum page requirement and budget expectations for Broader Impacts activities.	24
Guidance should include as a potential consideration – evaluation of the principal investigator’s prior Broader Impacts work.	18

Guidance should reduce emphasis on advancing knowledge and STEM education/training.	17
Guidance should emphasize/clarify enhancement of infrastructure.	16
Guidance should reduce emphasis on societal benefits.	16
Guidance should clarify that Broader Impacts criterion is as equally important as Intellectual Merit criterion.	15
Guidance should establish a quantitative metric.	15
Guidance should reduce emphasis on enhancing infrastructure.	12
Guidance should reduce emphasis on dissemination of research findings.	11
Guidance should require literature reviews to show principal investigator's understanding of prior knowledge and best practices.	6

Additional Comments

Question 26 asked respondents: "If you have any additional comments including suggested improvements to NSF's Merit Review criteria or related issues, please provide them below". 840 comments were received. Multiple themes could appear in one comment. All themes are presented.

Table 5. *If you have any additional comments including suggested improvements to NSF's Merit Review criteria or related issues, please provide them below*

Theme	Frequency (of 840)
NSF should ensure a fair, thorough, evidence-based, and consistent review with feedback.	129
NSF should recruit reviewers that are qualified to evaluate merit; Select discipline-specific, experienced and diverse background experts.	76
NSF should emphasize the greater importance of Intellectual Merit; Broader Impacts is not as important (at most a tiebreaker).	75
Current criteria results in a bias against new, small, teaching, rural or homogenous principal investigators/institutions in favor of insiders and big names. NSF should ensure no conflicts of interest.	75
NSF should clarify the definition and expectations for Broader Impacts criterion's potential considerations.	74
NSF should evaluate project outcomes against proposed Intellectual Merit/Broader Impacts activities to ensure compliance; NSF should reward successful principal investigators.	73
NSF should tailor criteria/review to different disciplines, proposals, and institutions	66
Principal investigators lack the knowledge, time, or resources to do Broader Impacts activities plus research; Too much time spent on proposals and reporting.	56
Principal investigators pay lip service to Broader Impacts; Too many boilerplate, politically correct responses.	55
NSF should clarify the definition and expectations for Intellectual Merit criterion's	48

potential considerations.	
NSF should revise templates and provide technical guidance (page/submission limits, separate sections and budget).	46
NSF should emphasize principal investigator qualifications (prior research, publications, and patents).	44
NSF should eliminate or significantly reduce Broader Impacts; NSF should only support fundamental science.	42
NSF should clarify the difference and relative weights between the Merit Review criteria.	38
NSF should create a separate principal investigator appeal and resubmission mechanism; Allow PIs to rate the quality of reviewers.	36
NSF should encourage greater Intellectual Merit/Broader Impacts role for institutions or NSF; More internal review, integrate with existing activities, seed funds for preliminary data, etc.	35
NSF should emphasize importance of Broader Impacts - It is often overlooked and not given much weight.	34
NSF should separate the review process for Intellectual Merit vs. Broader Impacts; there should be separate RFP/funding for Broader Impacts.	34
Improve communications between NSF, principal investigators, and reviewers (forums, chats, site visits).	33
NSF should establish a mechanism to fairly reconcile differences and dominant/minority opinions.	32
NSF should provide training resources for principal investigator/reviewer development (workshops, seminars, training, panel rotations).	29
NSF should improve feedback memory of previous reviews; Resubmissions are often rejected despite including prior reviewer feedback.	28
NSF should emphasize transformative research – too much safe research supported.	26
NSF should provide accessible, specific examples of proposals with strong/weak Intellectual Merit/Broader Impacts.	25
It is difficult to evaluate proposed Intellectual Merit/Broader Impacts or predict Intellectual Merit/Broader Impacts outcomes; Broader Impacts is subjective and outside principal investigator control.	25
More, continuous or matching NSF funding needed for both Intellectual Merit and Broader Impacts.	24
NSF should give reviewers need more flexibility, time, compensation and resources (or less load) to provide informative feedback.	23
NSF should reduce emphasis on transformative research and eliminate bias against basic, incremental research.	21
NSF should ensure organized and well-conceived proposals with clear objectives,	21

definitions, methodology, and evaluation.	
NSF should institute more quantitative review of Intellectual Merit/Broader Impacts (metrics, scores, rubrics, rankings).	20
NSF should emphasize science, technology, engineering and math education, career development and underrepresented group participation.	19
NSF should account for long-term outcomes and changes from original proposal in reporting; Do not micromanage project.	19
NSF should clarify that Broader Impacts activities do not have to be innovative; Principal investigators already do most Broader Impacts activities as part of their job.	19
NSF should expedite the review process to provide time for principal investigators to revise and resubmit.	18
NSF should conduct a study on effectiveness of merit review process and impacts of NSF funded research.	16
NSF should conduct dual-disclosure or double-blind reviews to ensure accountability.	15
NSF should reduce emphasis on principal investigator qualifications and access to resources.	14
NSF should establish balance between in-person panel reviews and mail-in reviews.	14
NSF should add an international or external review panel to review proposals and reports.	14
NSF should explicitly disclose amount of NSF funds available – Clarify amounts available by proposal, institution and discipline.	13
NSF should broaden Intellectual Merit/Broader Impacts to include more disciplines, activities, and impacts.	13
NSF should simplify the guidelines; Consolidate/cut certain parts of the criteria.	13
NSF should provide user-friendly guidance on the proposal review process and system.	12
NSF should address PD/PO/reviewer terms to ensure consistency of reviews (term limits).	12
NSF should clarify the weighting of potential considerations.	11
NSF should provide guidance on integrating Broader Impacts activities with Intellectual Merit; Broader Impacts and Intellectual Merit often unrelated.	11
NSF should clarify/expand what qualifies under science, technology, engineering, and math education and training and underrepresented group participation.	10
NSF should increase the award rate by rewarding multiple small grants over few large ones.	9
NSF should emphasize societal benefits, broad dissemination and contributions to infrastructure.	9
NSF and current criteria need fundamental change (mission, criteria overhaul).	9
NSF should emphasize feasibility and long-term sustainability of the proposed Broader Impacts; Ensure sufficient resources to complete Broader Impacts.	8

NSF should emphasize interdisciplinary research.	7
NSF should clarify what qualifies for transformative Intellectual Merit/Broader Impacts and balance of that with incremental.	7
NSF should set data/reporting requirements to better evaluate project outcomes; Limit requirements due to costs/time.	7
NSF should encourage greater collaboration between departments, institutions and nations.	7
NSF should clarify that Broader Impacts activities must go beyond principal investigator's normal activities/audience; Emphasize innovative or transformative Broader Impacts.	6
NSF should clarify what activities qualify as benefits to society and outreach.	4
NSF should reduce emphasis on science, technology, engineering, and science education and training and underrepresented group participation.	3
NSF review should emphasize timeliness of proposed research.	2
NSF should emphasize literature reviews to show principal investigator understanding of prior knowledge and best practices.	2
Intellectual Merit/Broader Impacts is primarily the responsibility of the principal investigator; Institutions/NSF should not interfere.	1

Responses accompanying “other” choices to close-ended questions.

Question 5 asked: “In preparing the proposal(s) you submitted to NSF during the past 2 to 3 years, how useful was information you obtained regarding the Intellectual Merit criterion from each of the following sources?” 238 respondents choose “Other – please specify below”; however, more than 350 comments were received. Table 6 displays the common themes and frequencies from the 244 comments addressing sources of information. (The remaining comments had nothing to do with the question.)

Table 6. *Other sources of information regarding the Intellectual Merit criterion.*

Theme	Frequency (of 238)
Serving as a reviewer/panel member	92
Special NSF training/conferences/site visits	41
Myself/professional expertise and experience	39
Reading successful proposals	32
Colleagues (i.e., Department Chairs, Advisor, etc.)	7
Blogs, Google searches, the Internet in general	7
Literature	6
Books	6
Previous reviewer comments on my proposals	6
Program solicitation	3
Other government officials (outside NSF)	3
Professional grant writer	1

Question 6 asked: “In preparing the proposal(s) you submitted to NSF during the past 2 to 3 years, how useful was information you obtained regarding the Broader Impacts criterion from each of the following sources?” 245 respondents choose “Other – please specify below”; however, 300 comments were received. Table 7 displays the common themes and frequencies of common themes from the 212 comments addressing sources of information. (The remaining comments had nothing to do with the question.)

Table 7. *Other sources of information regarding the Broader Impacts criterion.*

Theme	Frequency (of 212)
Serving as a reviewer/panel member	96
NSF training/workshops	32
Reading successful proposals	31
Colleagues (i.e., Department Chairs, Advisor, etc.)	14
Myself/professional expertise and experience	13
Program solicitation	9
Blogs, the Internet in general	8

Books	4
Local outreach coordinators/stakeholders	4
Other government officials (outside NSF)	3
Literature	3
Professional Grant Writers/Consultant	2

Question 8 asked: “Based on your experiences submitting proposals to NSF during the past 2 to 3 years, how much weight did reviewers place on the Intellectual Merit criterion compared to the Broader Impacts criterion in the NSF review process?” 55 respondents choose “Other – please explain in comment section”. 426 comments were received. 189 of those comments did not address the topic of the question. The 175 on-topic comments’ themes are summarized in Table 8.

Table 8. *Principal Investigator’s “other” weights reviewers placed on the criteria.*

Themes	Frequency (of 175)
Reviewers currently ignore Broader Impacts, used an excuse to reject proposals, treated as an afterthought, and/or check box	81
Depended on program/proposal	78
Broader Impacts was used as a tiebreaker	17
All weight was placed on Broader Impacts	8

Question 9 asked: In your opinion, how much weight should reviewers place on the Intellectual Merit criterion compared to the Broader Impacts criterion when evaluating proposals in subject areas such as yours? 89 respondents choose “Other – please explain in comment section”. 424 comments were received. 164 of which did not address the topic of the question. The 260 on-topic comments’ themes are summarized in Table 9.

Table 9. *Principal Investigator’s “other” weights reviewers should be placed on the criteria.*

Theme	Frequency (of 260)
Depends on program/proposal	90
All weight should be placed in Intellectual Merit	74
Without strong Intellectual Merit, there can be no Broader Impacts	52
Broader Impacts criteria Unclear/Misunderstood	43
Specific numbers (average 80% Intellectual Merit, 20% Broader Impacts)	9

Question 16 asked: “As a reviewer, how useful was information you obtained regarding the Intellectual Merit criterion from each of the following sources in assessing the proposals you reviewed during the past 2 years?” 208 respondents choose “Other – please specify below”; however, more than 282 comments were received. Table 10 displays the common themes and frequencies of these themes from the 216 comments addressing sources of information. (The remaining comments had nothing to do with the question.)

Table 10. *Other sources of Intellectual Merit information.*

Theme	Frequency (of 216)
Myself/professional expertise and experience	78
Serving as a reviewer/panel member	42
Solicitation for review information	41
Literature	37
Other government organizations	10
Colleagues	9
Other principal investigator info/citations	8
Blogs, Google searches, the Internet in general	6
Previous reviewer comments on my proposals	5

Question 17 asked: “As a reviewer, how useful was information you obtained regarding the Broader Impacts criterion from each of the following sources in assessing the proposals you reviewed during the past 2 years?” 188 respondents choose “Other – please specify below”; however, 212 comments were received. Table 11 displays the common themes and frequencies of common themes from the 135 comments addressing sources of information. (The remaining comments had nothing to do with the question.)

Table 11: *Other sources of Broader Impacts information.*

Themes	Frequency (of 135)
Serving as a reviewer/panel member	49
Myself/professional expertise and experience	41
Solicitation for review information	31
Reading Successful Proposals	12
Blogs, Google searches, the Internet in general	6
Colleagues	3
Books	2

Question 18 asked: “Based on your experiences as an NSF review panel member during the past 2 years, how much weight did other reviewers typically place on the Intellectual Merit criterion compared to the Broader Impacts criterion?” 66 respondents choose “Other – please specify below”; however, 169 comments were received. Table 12 displays the common themes and frequencies of common themes from the 94 comments directly address how reviewers weighted the criteria. (The remaining comments had nothing to do with the question.)

Table 12: *Other weighting of the criteria by reviewers.*

Theme	Frequency (of 169)
Depended on program/proposal	44
Broader Impacts was used as a tiebreaker/disqualifier	40
Broader Impacts was extensively considered	5
Placed the most weight on the Principal Investigator’s qualifications	4

Question 19 asked: “In your opinion, how much weight should reviewers place on the Intellectual Merit criterion compared to the Broader Impacts criterion?” 50 respondents choose “Other – please explain in comment section”. 382 comments were received. 153 of which did not address the topic of the question. The 229 on-topic comments’ themes are summarized in Table 13.

Table 13: *Reviewers’ responses of other weightings of Merit Review criteria reviewers should place.*

Theme	Frequency (of 153)
Depended on program/proposal	88
Without strong Intellectual Merit, there can be no Broader Impacts	62
All weight should be placed on Intellectual Merit	55
Broader Impacts should be used as “tie breaker”/ reason to decline	17
Specific numbers (avg. 75% Intellectual Merit)	12

Appendix D

STPI Summary Report of Web Site Comments



MEMORANDUM

June 14, 2011

To: Kim Silverman, National Science Board Office (NSBO)
Joanne Tornow, National Science Foundation (NSF)

From: Rachel Parker, Science and Technology Policy Institute (STPI)

CC: Sallie Keller, STPI

Subject: Merit Review Task Force: Stakeholder Input Analysis Findings

In support of a larger study being conducted by the National Science Board's Merit Review Task Force, the NSBO asked STPI to provide an analysis of responses to a public Request for Information (RFI) related to the Merit Review Criteria of the NSF.

STPI coded and analyzed the responses to five open-ended questions in the RFI using content analytic methods to refine the key themes emergent throughout the data. The outcomes of the analysis for each question in the RFI are enclosed in the attached report. The analysis includes a section that briefly highlights the overlap between the responses collected through the RFI and the goals laid out by Congress in the reauthorization of the America COMPETES Act.

There were several limitations to analyzing the data gathered from responses to the RFI. Notably, the lack of structure in the open-ended questions appears to have led respondents' answers to stray significantly from the question(s) asked. Also, STPI was not provided the data in its original format. The data were pre-divided into unique responses for each of the five questions, and our analysis was based on this division. However, the data showed there may be instances in which a single respondent's answers may have been divided inaccurately across more than one response. Similarly, more than one individual's response may have been included in what appears to be a unique response.

Despite these limitations, the data reveal trends that may provide support to the Task Force, the larger Board, and the NSF more broadly.

Attachments: "Merit Review Criteria Stakeholder Input Analysis: Findings"

"Appendix A: Codebook for Questions 1-5"

"Appendix B: Sample Quotes within Codes"

Merit Review Criteria Stakeholder Input Analysis: Findings

Asha Balakrishnan

Susannah Howieson

Mary Beth Hughes

Allison Laskey

Elizabeth Lee

Amy Marshall Richards

Brent Miller

Mario Nunez

Rachel Parker, *Task Leader*

June 14, 2011

Executive Summary

The IDA Science and Technology Policy Institute (STPI) analyzed data compiled from responses to a Request for Information (RFI) solicited by the National Science Board's Task Force on Merit Review Criteria. A summary of our findings, arranged in the order of the five questions posed by the RFI, follows.

Question 1 (*What do you see as the strengths and weaknesses of each criterion?*) responses were generally positive with regard to the Intellectual Merit criterion, while responses regarding the Broader Impacts criterion were mixed. Many respondents stated that Intellectual Merit should be an important part of the NSF review of proposals, while fewer respondents stated Intellectual Merit was not important at all. More respondents stated that Broader Impacts should be an important part of the NSF review of proposals than stated that it was an unimportant component or had no effect on society, but by a smaller margin. Overall, respondents reported they felt the definition of Intellectual Merit was strong, but that the definition for Broader Impacts could be clearer. Responses about both the Intellectual Merit and Broader Impacts criteria indicated a need for additional reviewer training and implementation, but the number of such responses was higher with respect to the Broader Impacts criterion.

Question 2 (*What changes, if any, would you like to see made to the Merit Review criteria?*) responses indicated a strong desire for changed to the Broader Impacts criterion. Fewer respondents desired changes to the Intellectual Merit criterion. More than four times as many respondents recommended changes to the Broader Impacts criterion as recommended leaving it unchanged, while approximately twice as many respondents recommended changes to the Intellectual Merit criterion as recommended leaving it unchanged.

Question 3 (*What role should the institution play to ensure that the intellectual merit and broader impacts in NSF proposals can be realized?*) responses were considerably diverse. Half of the respondents offered actions their home institution might take, one quarter suggested potential actions of the NSF, and one quarter were ambiguous as to which organization was being discussed. The majority of respondents stated that the home institution should increase support for broader impacts by establishing institutional mechanisms for those activities, increasing financial or in-kind support, or encouraging involvement in broader impacts through changes in value systems and incentives. Respondents who interpreted the question with respect to the NSF wrote in terms of

keeping or changing the merit review criteria, reiterating points largely already covered in their responses to the preceding question.

In response to Question 4 (*What impact, if any, has NSF's two review criteria had on how you think about developing your research projects?*), a greater number of respondents reported that the Broader Impacts criterion had an effect on their research than did respondents for the Intellectual Merit criterion. Respondents wrote about the Broader Impacts criterion almost three times as often as they wrote about the Intellectual Merit criterion. Both positive and negative effects were identified for each criterion. Approximately one-half the respondents found the impact of Broader Impacts on the development of their research projects to be positive and one-half found it to be either neutral or negative. The majority of respondents were positive about the impact of Intellectual Merit and no respondents reported a negative impact. A substantial number of respondents said that the Broader Impacts criterion had no effect on the conduct of their research. A little less than half of the respondents who reported that broader impacts had no influence said it was because it was not taken seriously; these respondents paid “lip service” to the criterion in their grant applications, but it had no effect on how they performed their research projects. Approximately one-third of those who said the Broader Impacts criterion had no influence explained that they already engage in broader impacts activities and would continue to do so with or without the mandate of the criterion. The remainder of the responses either did not understand what the Broader Impacts criterion entailed or found the reviews of their proposals inconsistent, leading them to be unsure how to apply the criterion to their research; or felt that they were unable to engage in broader impacts activities due to their scientific field or lack of funding.

Question 5 (*Any other comments?*) responses were so diverse that no major themes emerged; however, many responses were similar in that they provided suggestions for change.

Although the bulk of STPI's analysis focuses on respondents' answers to the specific questions, the following general attitudes emerged:

- Satisfaction with the Intellectual Merit criterion.
- Appreciation of the conceptual value of the Broader Impacts criterion.
- Frustration with the implementation of the Broader Impacts criterion.
- Dissatisfaction with processes surrounding proposal reviews.

In general, respondents paid far more attention to the Broader Impacts criterion than to the Intellectual Merit criterion in their responses across the RFI.

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Question 1: What do you see as the strengths and weaknesses of each criterion?	2
Question 2: What changes, if any, would you like to see made to the Merit Review criteria?	6
Question 3: What role should the institution play to ensure that the intellectual merit and broader impacts in NSF proposals can be realized?	11
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Introduction

The National Science Board Office (NSBO) asked the IDA Science and Technology Policy Institute (STPI) to provide an analysis of responses to a public Request for Information (RFI) related to the Merit Review Criteria of the National Science Foundation. The RFI is in support of a larger study being conducted by the National Science Board's Merit Review Task Force. The RFI contained the following five open-ended questions:

1. What do you see as the strengths and weaknesses of each criterion?
2. What changes, if any, would you like to see made to the Merit Review criteria?
3. What role should the institution play to ensure that the intellectual merit and broader impacts in NSF proposals can be realized?
4. What impact, if any, has NSF's two review criteria had on how you think about developing your research projects?
5. Any other comments?

The table below provides the numbers of unique responses STPI received for each of the five questions (Table 1).

Table 1. Number of Unique Responses

Question Number	Number of Responses
Question 1	445
Question 2	477
Question 3	362
Question 4	380
Question 5	282

STPI used content analytic methods to code and classify the data according to the themes present throughout the responses. STPI analyzed the responses using QSR International's NVivo qualitative data management software program. The coding process was iterative and inductive. Data were grouped into themes to allow for more detailed analysis. For each set of responses the codes were applied allowing for the data to be refined, and the nuances drawn out. It is possible for one respondent to have discussed several themes throughout one response to any given question. In such cases, to fully understand the nuances of the respondent's answer to a question, more than one code would have been applied. Numbers of unique responses, and whether the codes

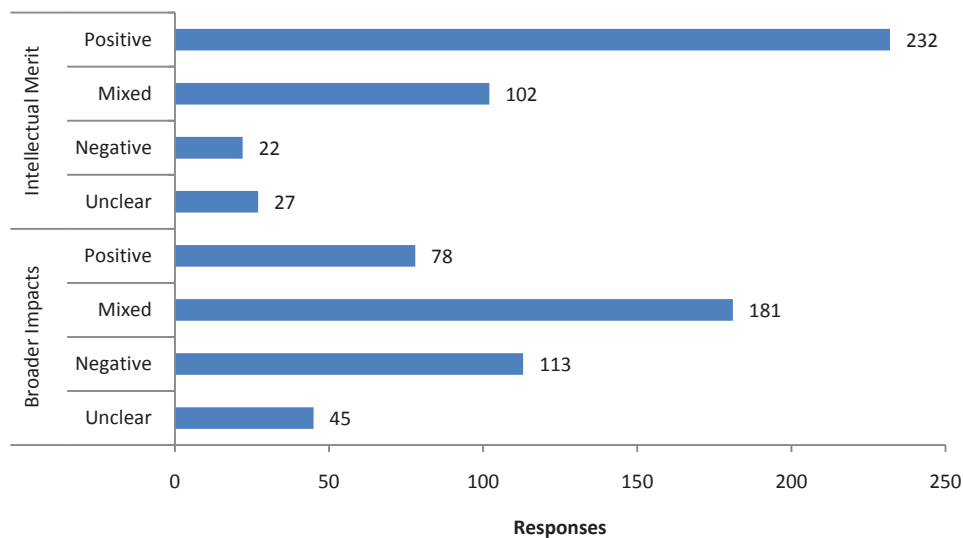
applied were mutually exclusive or not, are included for each figure to reinforce this point.

The codebook containing a glossary of the codes developed, including brief explanations and sample quotes for each code, appears in Appendix A. Appendix B includes a complete list of quotations for a selection of salient themes running through the responses.

Question 1: What do you see as the strengths and weaknesses of each criterion?

Responses to this question were coded separately for each criterion (Figure 1). Some respondents, however, did not address both criteria in their responses. Sixty-two respondents did not address Intellectual Merit, and 28 respondents did not address Broader Impacts.

Figure 1. Was the response about the criteria positive, negative, or mixed? (Codes are mutually exclusive; data represent 445 unique responses)



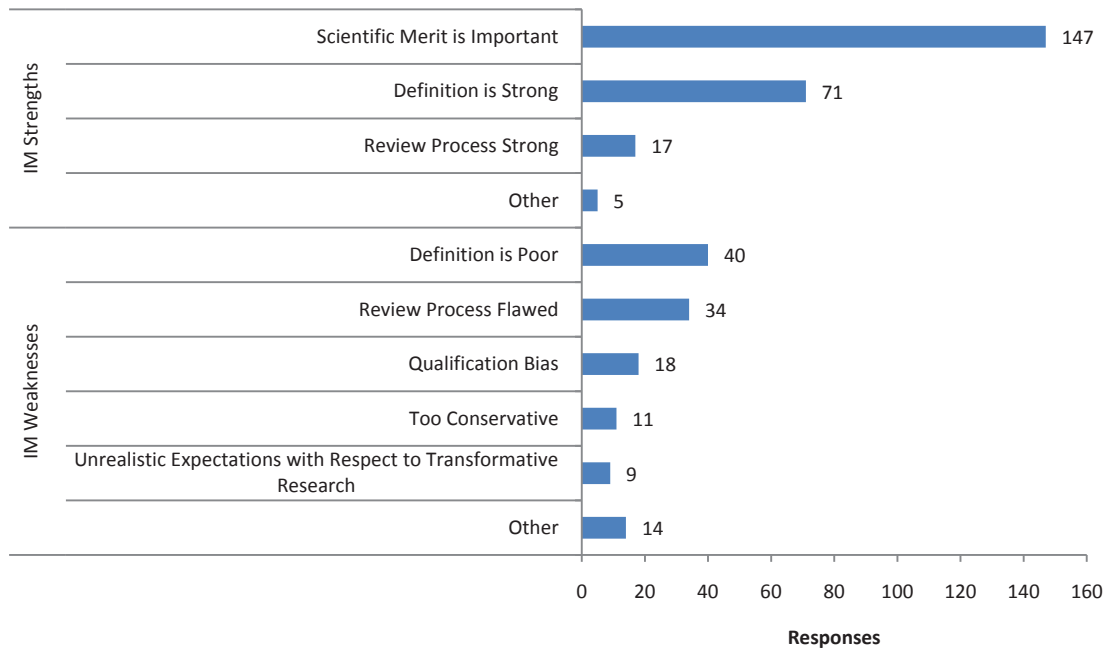
Responses were first assessed on whether they referred to the Intellectual Merit or the Broader Impacts criterion, and whether the statement was an overall positive, negative, or mixed (containing both positive and negative sentiments) sentiment. If the response was referring to a specific criterion but it was not clear whether the respondent was stating something positive or negative, the response was coded as unclear.

- Over half (232 responses, 52%) of the respondents had positive sentiments towards the Intellectual Merit criterion, 102 had mixed sentiments (23%), and only 22 respondents had negative sentiments (5%).

- For the Broader Impacts criterion, 78 respondents (18%) had positive sentiments, 181 had mixed sentiments (41%), and 113 had negative sentiments (25%).

Following this initial coding, the responses were then assessed on the specific strengths and weaknesses identified for each criterion.

Figure 2. What are the strengths and weaknesses of the Intellectual Merit criterion? (Codes are not mutually exclusive; data represent 383 unique responses)



When addressing the Intellectual Merit criterion (Figure 2),

- The most commonly heard theme is that **scientific merit is important** to consider and is thus a strength of the criterion (147 responses, 38%).
- A large proportion of responses (71, 19%) acknowledged that one strength of the criterion is that it is **well-defined**. A smaller number of responses (40, 10%) seemed to disagree, stating that the criterion’s **definition is poor**.
- Some responses (34, 9%) specifically criticized the review process with respect to the Intellectual Merit criterion. Twice as many responses included a statement that the **review process is flawed** (34, 9%) as those who stated that the **review process is strong** (17, 4%).
 - An example of a response coded as **review process flawed** is:

“Intellectual merit does a nice job conveying the scientific quality of the ideas, but too often I see reviews that fail to seriously consider whether the research plan, or the research team, is adequate to actually achieve or make progress on the ambitious goals.”

– An example of a response coded as **review process strong** is:

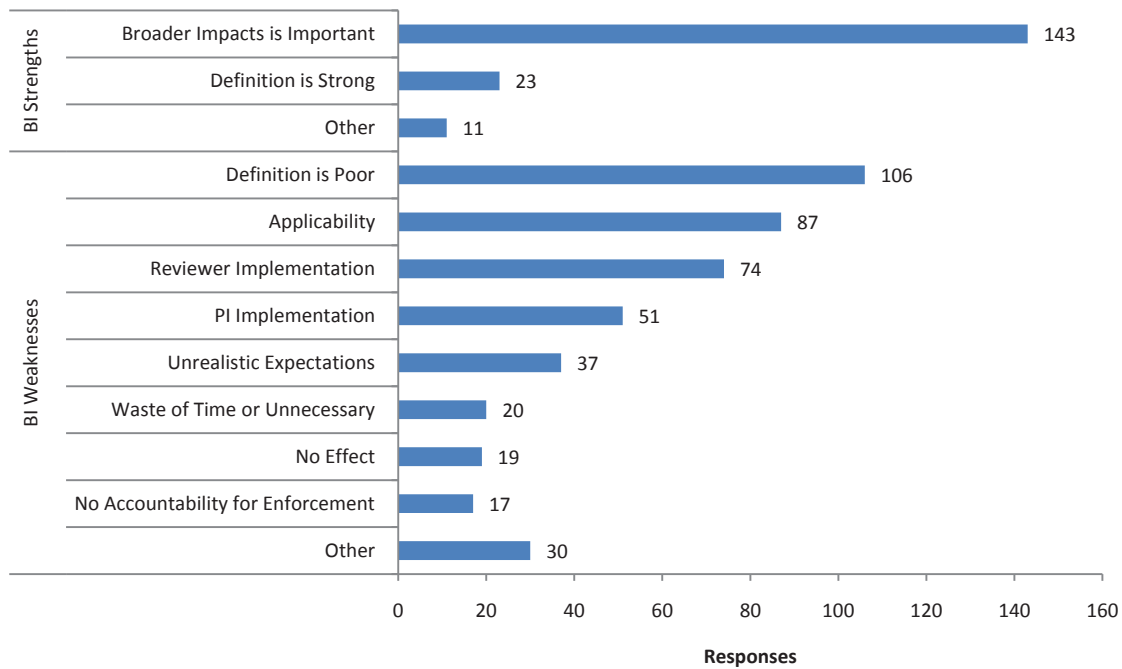
“It is my impression that NSF does a commendable job of obtaining outside reviews, and convening panels of knowledgeable reviewers for making recommendations.”

- In relation to the total number of strengths and weaknesses counted, a small fraction of overall responses said the criterion had other weaknesses. Eighteen responses (5%) thought there was a **qualifications bias** in favor of the reputations of certain PIs or institutions, thus penalizing new investigators and investigators from less prestigious backgrounds.

– An example of a response coded as **qualifications bias** is:

“This criteria generally favors students/PIs from more established research institutions, and puts students/PIs from smaller institutions which may not be as established or with as much infrastructure at a big disadvantage.”

Figure 3. What are the strengths and weaknesses of the Broader Impacts criterion? (Codes are not mutually exclusive; data represent 417 unique responses)



When addressing the Broader Impacts criterion (Figure 3):

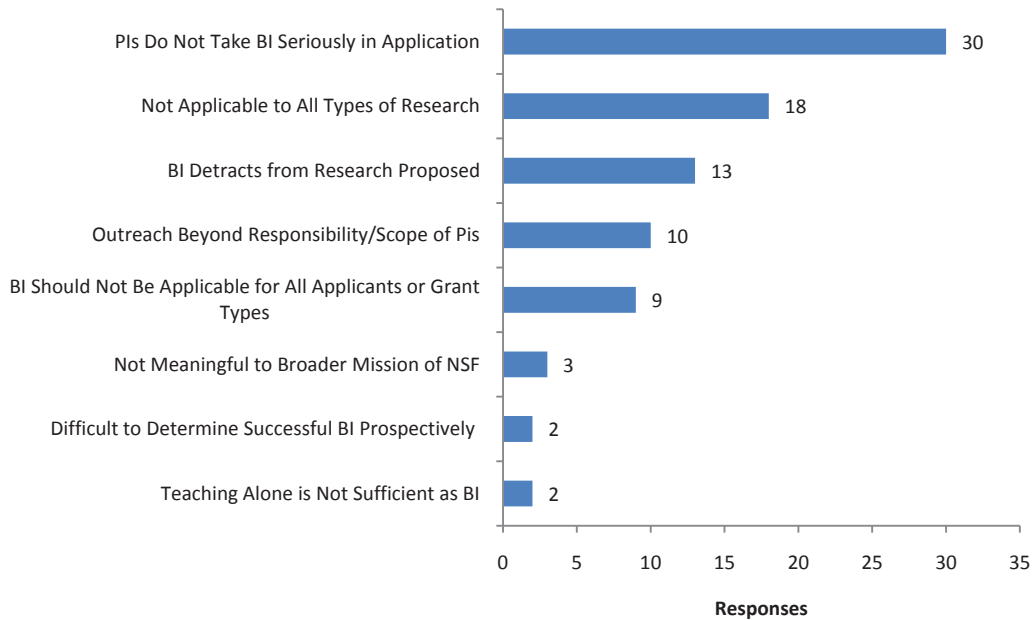
- Of the 177 statements that discussed the strengths of Broader Impacts, a notable majority (143 responses, 81%) said that the **Broader Impacts criterion is important**.¹
- There were 441 statements that discussed the weaknesses of Broader Impacts. The most commonly heard theme (106, 24%) was that the criterion's **definition is poor**.²
- Another common theme in the weakness responses (87, 20%) was that the criterion is **not applicable** to all research proposals – that is, that many research projects do not have a natural path for leading to a broader impact or that it distracts from the central scientific endeavor.
- 74 responses (17%) stated that **reviewer implementation** was a weakness, i.e., reviewers use the criterion incorrectly, inappropriately, or inconsistently.
 - An example of a response coded under **reviewer implementation** is:
“The weakness of the broader impact criteria is that it either is used in panels as a way of rejecting high risk basic research or it turns into filler on socially acceptable issues.”
- 51 responses (12%) stated that **PI implementation** was a weakness, i.e. applicants submitted formulaic text in proposals, did not intend to implement BI activities, or that their activities lack meaningful impact.
 - An example of a response coded under **PI implementation** is:
“The Broader Impacts criterion has largely forced PIs to spend time talking to kids and teachers about science. This sounds good in theory, but in practice scientists untrained in K-12 pedagogy and instructional methods are being forced to spend time teaching K-12 students. I’ve not seen any evidence that these activities have really done anything to improve STEM education.”

The 87 responses under applicability were coded further in order to understand the ways in which respondents believed the Broader Impacts criterion was not applicable to the NSF review process (Figure 4).

¹ Percentage was calculated using the 177 statements that noted strengths of the Broader Impacts criterion as the denominator.

² Percentage was calculated using the 441 statements that noted weaknesses of the Broader Impacts criterion as the denominator.

Figure 4. In what ways is the Broader Impacts criterion not applicable to the NSF review process? (Codes are mutually exclusive; data represent 87 unique responses)

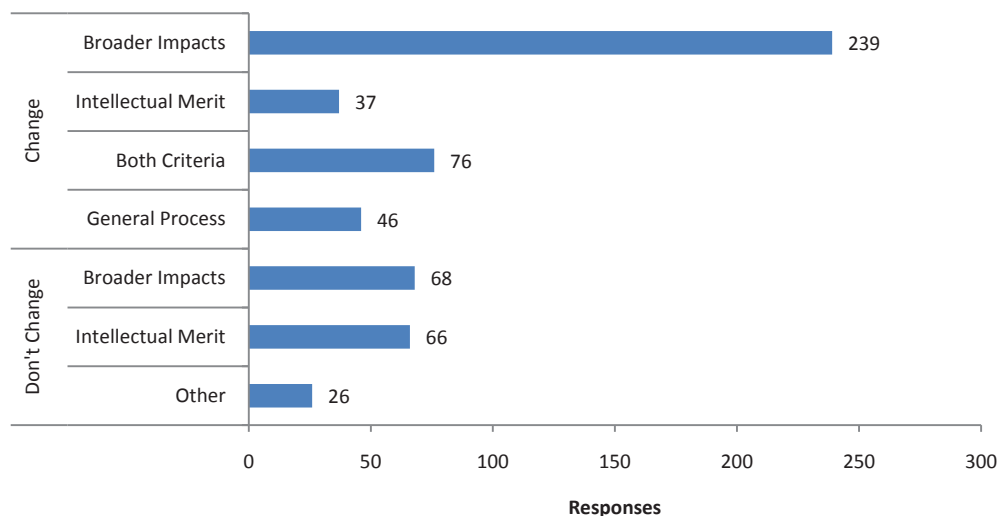


Respondents most commonly explained that **PIs do not take the Broader Impacts criterion seriously in their applications** (30 responses, 34%). Other respondents noted that the BI criterion is **not applicable to all types of research** (18, 21%); for instance, basic research is less likely to have immediately perceived broader impacts.

Question 2: What changes, if any, would you like to see made to the Merit Review criteria?

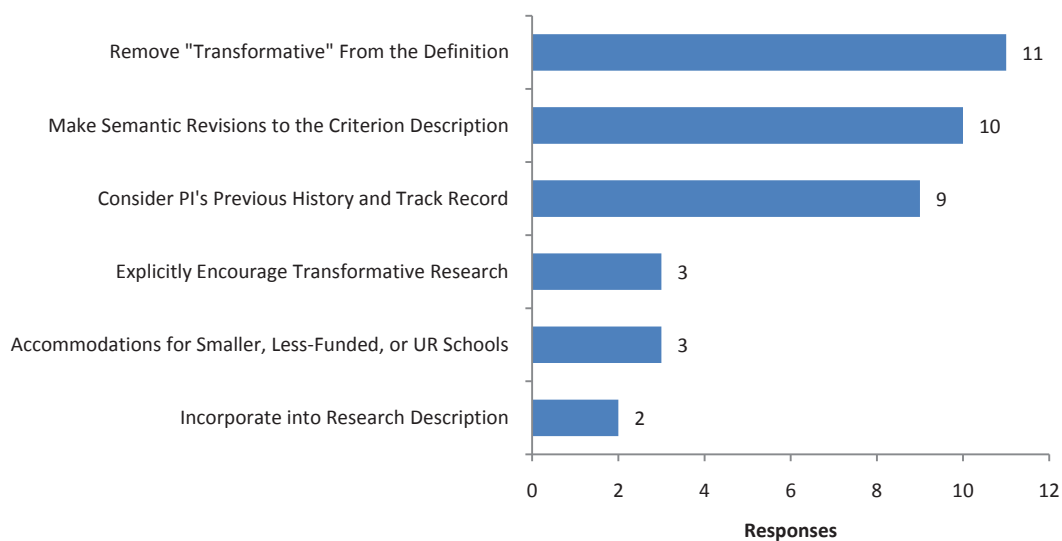
This question was first broken down into whether respondents suggested changes or not, and whether for either criterion, suggestions were given related to the review process, or other aspects of the merit review criteria (Figure 5).

Figure 5. Did the response recommend change or no change, and to which criteria? (Codes are mutually exclusive for each criterion; data represent 477 unique responses)



- The most common response (239 responses, 50%) recommended changes to the Broader Impacts criterion, whereas only 37 comments (8%) indicated that there should be changes made to the Intellectual Merit criterion.
- Seventy-six responses (16%) reported that both criteria need to be changed.

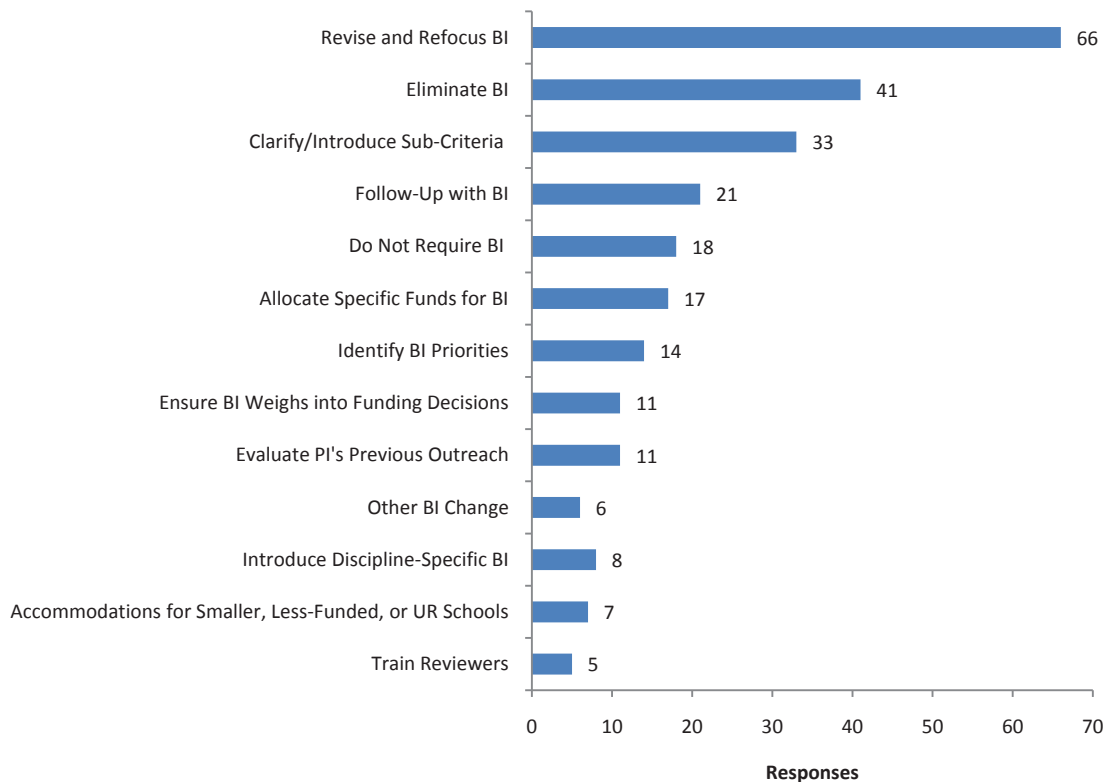
Figure 6. What changes should be made to the Intellectual Merit criterion? (Codes are not mutually exclusive; data represent 36 unique responses)



Of the respondents who suggested changes to the Intellectual Merit criterion (Figure 6), three responses were most common:

- **Remove “transformative” from the criterion** definition (11, 30%).
- **Modify the definition** or make other semantic revisions to the criterion description (10, 27%).
- **Consider the track record of the PI** or the PI’s previous history as part of the criterion (9, 25%).

Figure 7. What changes should be made to the Broader Impacts criterion? (Codes are not mutually exclusive; data represent 219 unique responses)

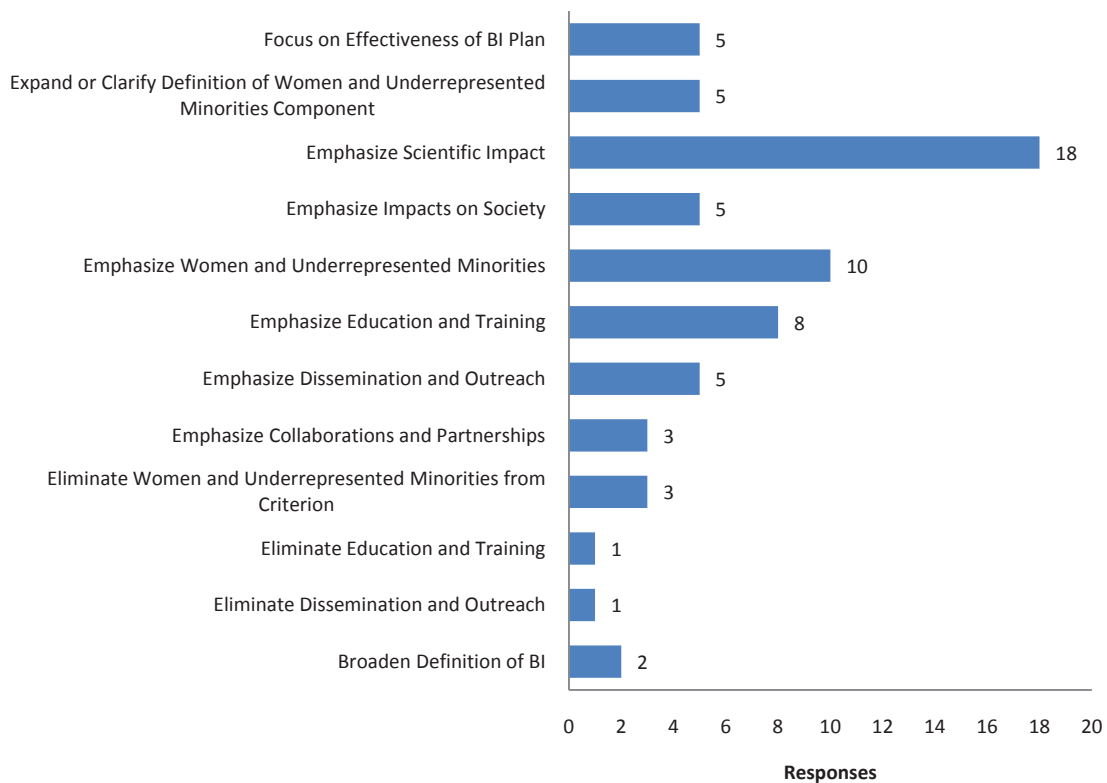


Of those who suggested changes to the Broader Impacts criterion (Figure 7), the most common responses were:

- NSF should **revise and refocus Broader Impacts** (66 responses, 30%).
- **Eliminate Broader Impacts** as a criterion (38, 17%)
- **Introduce sub-criteria** (25, 11%) that can be used as checklist for satisfying the criterion by applicants and reviewers.

The 66 responses that suggested that NSF revise and refocus the Broader Impacts criterion were further coded to identify what substantive recommendations were made (Figure 8).

Figure 8. In what ways did respondents suggest that the Broader Impacts criterion be revised and refocused? (Codes are mutually exclusive; data represent 66 unique responses)



Of those that suggested that NSF revise and refocus Broader Impacts (Figure 8), the most common suggestions were:

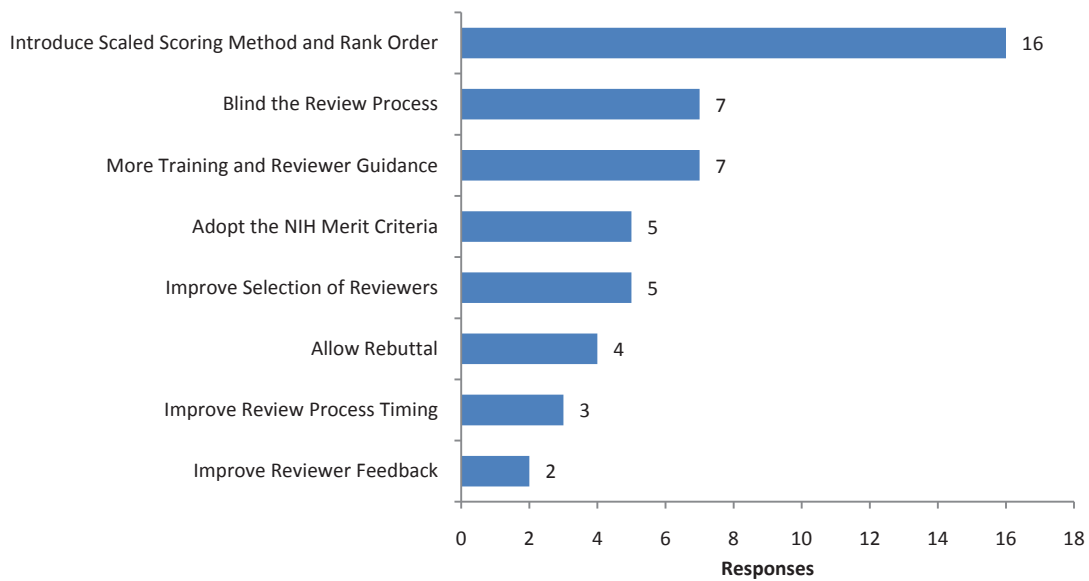
- **Emphasize the scientific impact** in the criterion (18 responses, 27%).
 - An example of a response coded as **emphasize the scientific impact** is:

“Perhaps the broader impact criterion could be expanded to consider the extent to which project results will advance the field in practical, substantive ways.”
- The second most common suggestion was to **emphasize women and underrepresented minorities** (10, 15%).
 - An example of a response coded as **emphasize women and underrepresented minorities** is:

“I would like each institution that has gotten grant money to have a specific plan on how to make sure that there are diversified individuals participating in awarded grants. In addition, there should be some type of diversity training for individuals who have get funding so that when a diverse person enters their group they will be better able to communicate and advise them.”

Respondents made a range of suggestions as to how the application and review process could be changed (Figure 9).

Figure 9. What changes should be made to the application and review process? (Codes are not mutually exclusive; data represent 68 unique responses)



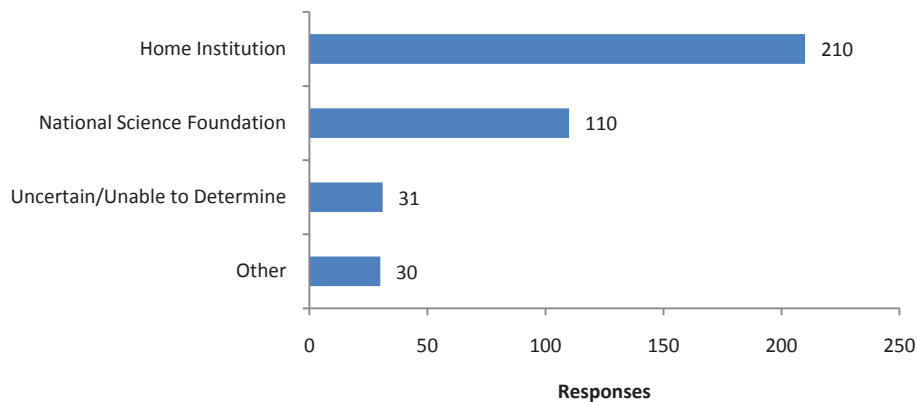
The most common suggestions for changes to the application and review process were:

- Reintroduce the **scaled scoring method** to standardize application ranking (16 responses, 24%).
- **Blind the review process** to increase transparency in the selection system (7, 10%).
- Provide more **training and reviewer guidance** to improve consistency across reviewers (7, 10%).

Question 3: What role should the institution play to ensure that the intellectual merit and broader impacts in NSF proposals can be realized?

Respondents interpreted question 3 in differing ways. STPI initially categorized the responses based on whether the respondent was referring to their home institution, NSF or it was unclear (Figure 10).

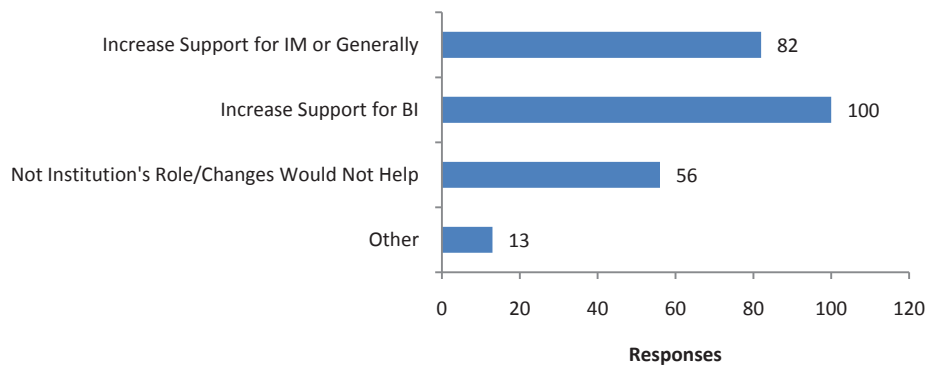
Figure 10. Was the respondent referring to Home Institution, the National Science Foundation, Uncertain/Unable to Determine, or did they have other comments? (Codes are not mutually exclusive; data represent 362 unique responses)



- The majority of respondents (210 responses, 58%) commented regarding their home institution.
- The 31 (9%) Uncertain/Unable to Determine responses were further coded into the subject areas discussed. Thirteen responses stated that there was **no role for the “institution”** in ensuring that the merit review criteria are met. Six respondents said that **no changes are needed** to the current role of the “institution.” Six responses indicated that the “institution” might play a role in **education, outreach, and monitoring of the criteria**. Six respondents made other comments that did not fall into any one of the above mentioned categories.
- Thirty responses (8%) were coded as other comments and included a range of topics which were neither focused on the role of the home institution or the NSF.

Suggested roles were broken down within each interpretation of “institution” (Home Institution, National Science Foundation). Comments related to the home institution were divided into what role respondents felt the home institution should play (Figure 11).

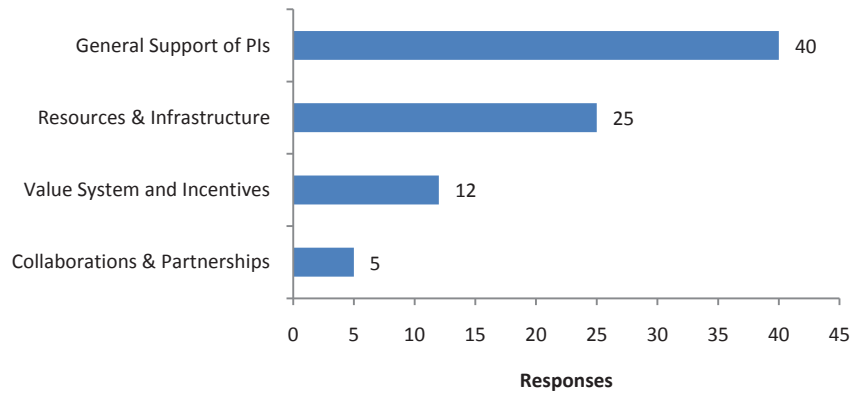
Figure 11. How can the home institution play a greater role in order to realize the goals of the merit criteria? (Codes are not mutually exclusive; data represent 195 unique responses)



The most frequent response was that the home institution should increase **support for broader impact** activities (100 responses, 51%). The remaining responses were split between those who thought the institution should **increase support for intellectual merit** or **increase support for the criteria generally** (82, 42%), and those who believed it was **not the institution's role** or that institutional **changes would not help** PIs to realize the goals of the criteria (56, 29%).

The code to **increase support for Intellectual Merit or the criteria in general** was further coded into four categories (Figure 12).

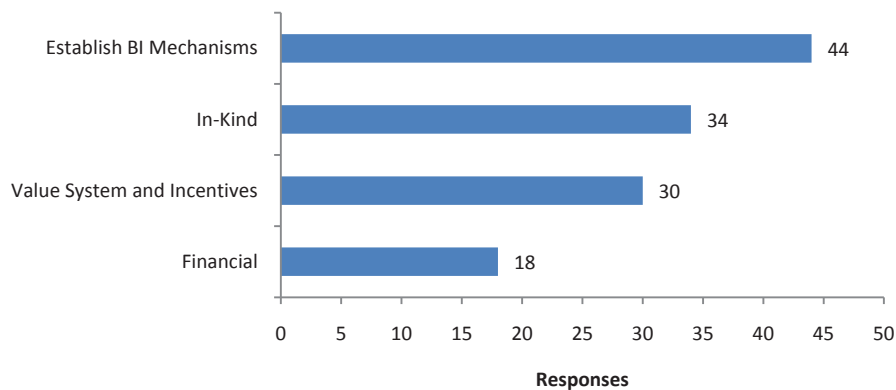
**Figure 12. How can the home institution increase support for Intellectual Merit or the criteria in general?
(Codes are not mutually exclusive; data represent 75 unique responses)**



Most respondents felt the home institutions should provide **general support for the PI** (40 responses, 53%) or devote more **resources and infrastructure** to research (25, 33%). Some respondents felt that their institutions could encourage implementation of NSF criteria through a **value system or incentives** (12, 16%), and a few felt their institution should encourage **more collaborations and partnerships** (5, 7%) to improve Intellectual Merit or the criteria generally.

Responses indicating suggested increases in support of the Broader Impacts criterion were further broken down into four sub-themes (Figure 13).

**Figure 13. How can the home institution increase support for Broader Impacts?
(Codes are not mutually exclusive; data represent 96 unique responses)**



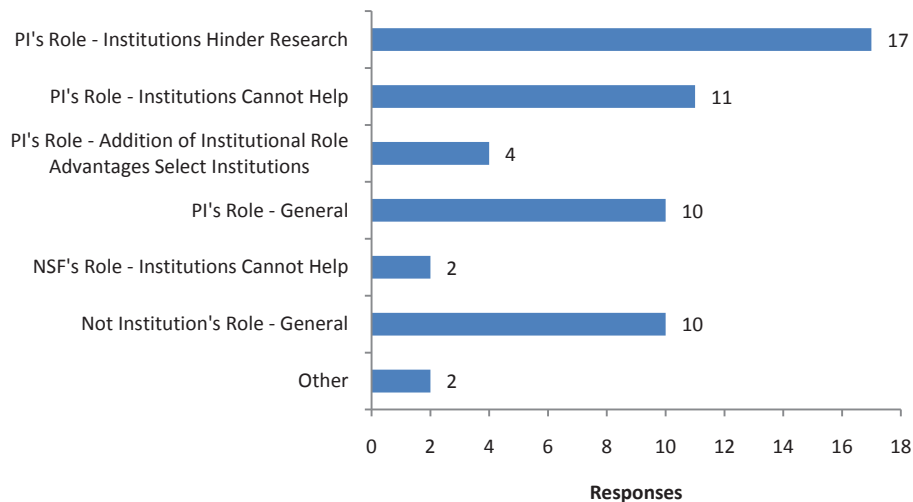
- The most popular suggestion was for the home institution to **establish mechanisms to support broader impact** (44 responses, 46%), possibly through

a centralized office. The office would be responsible for assisting PIs with media relations and community engagement, among other things.

- Respondents also recommended the home institution **provide in-kind support** such as infrastructure, space and administrative assistance (34, 35%); **establish a value system and incentives which encourage Broader Impacts** (30, 31%); and **devote financial resources** to PI’s undertaking broader impact activities (18, 19%).

Responses indicating that it is not the home institution’s role to ensure that the merit review criteria are met were further coded into seven sub-themes (Figure 14).

Figure 14. How did respondents justify their opinion that it is not the home institution’s role or that no changes can help to ensure that PIs meet the NSF review criteria? (Codes are mutually exclusive; data represent 56 unique responses)

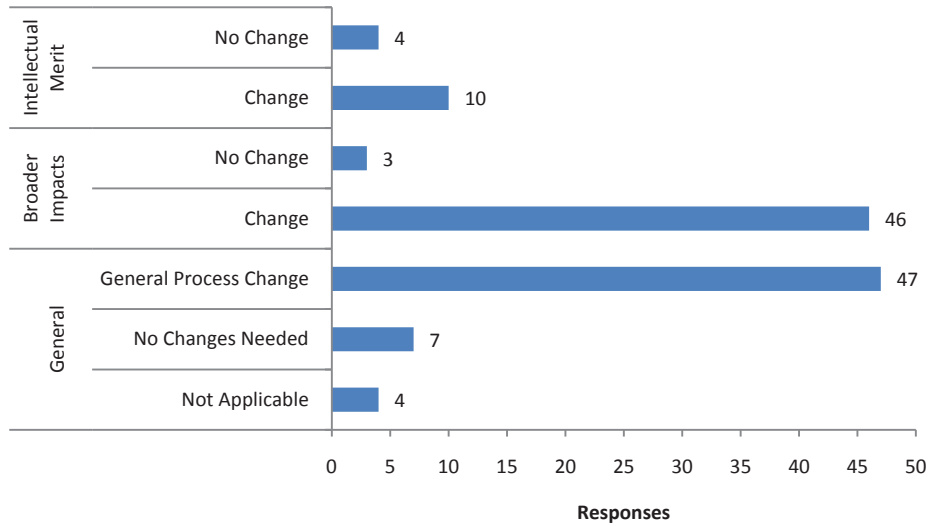


Of the 56 responses indicating that it is not the home institution’s role to ensure that PIs meet the review criteria, the most common responses were:

- It is the **PI’s role and institutions only hinder the research process** (17 responses, 30%).
- It is the **PI’s role and institutions cannot help** because they lack the aptitude to aid PIs in conducting sound science and lack the resources to fund broader impact activities (11, 20%)

Comments from respondents who thought the “institution” referred to NSF were also categorized into sub-themes (Figure 15).

Figure 15. What types of actions did respondents suggest the National Science Foundation take in order to realize the goals of the merit criteria? (Codes are not mutually exclusive; data represent 98 unique responses)

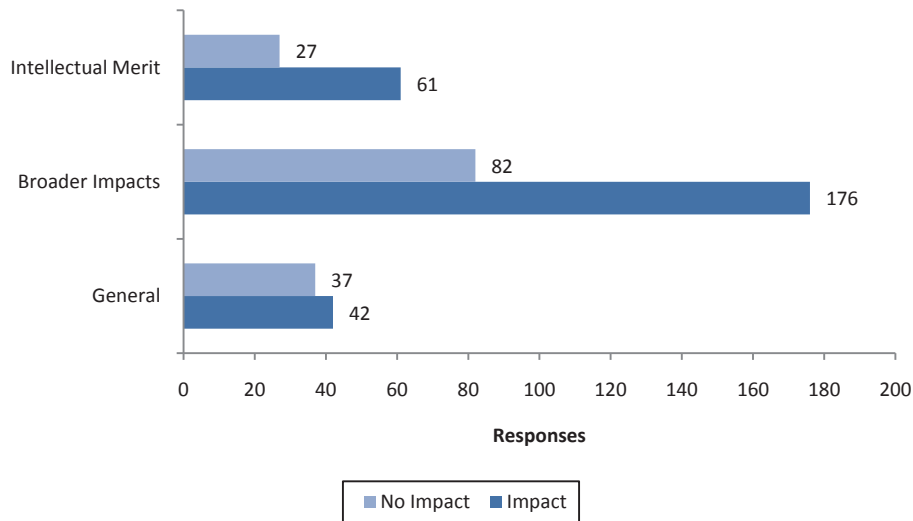


- The most common responses were that the **Broader Impacts criterion should be changed** (46 responses, 47%) and that **general process changes should be adopted** for the review process (47, 48%).
- The manner in which Broader Impacts criterion could be changed is further explored in question 2 *supra*.

Question 4: What impact, if any, has NSF’s two review criteria had on how you think about developing your research projects?

Responses were first categorized by which criterion they addressed (Intellectual Merit, Broader Impacts, or whether they addressed both criteria generally), and whether or not the criteria had an impact on the development of research projects or not (Figure 16).

Figure 16. Does the Broader Impacts criterion, Intellectual Merit criterion, or do the criteria in general have an impact on the development of research projects? (Codes are not mutually exclusive, data represent 348 unique responses, 32 question 4 responses were excluded as N/A)



- Respondents wrote about Broader Impacts criterion (258 responses, 74%) more than twice as often as they wrote about intellectual merit (88, 25%).³
- Of the 258 respondents who commented on Broader Impacts, more than twice as many said it had an **impact** on the development of their research projects (176, 68%) compared to those who said it had **no impact** (82, 32%).⁴
 - An example of a response coded as no impact on Broader Impacts is:

“Quite frankly, the ‘Broader Impacts’ section has always been a mystery to me, and I find it essentially draws away space that I think could be better used explaining the intellectual merit.”
- Of the 88 respondents who commented on **Intellectual Merit**, 61 said it had an **impact** on the development of their research projects (69%) and 27 said it had **no impact** (31%).⁵
 - An example of a response coded as no impact on Intellectual Merit is:

“The intellectual merit criterion is so central to evaluating science, that NSF adds little to my own research projects. I simply wouldn’t pursue

³ The 32 responses coded as N/A were not included in the denominator when calculating these percentages.

⁴ Percentages are calculated using the 258 respondents who commented on Broader Impacts as the denominator.

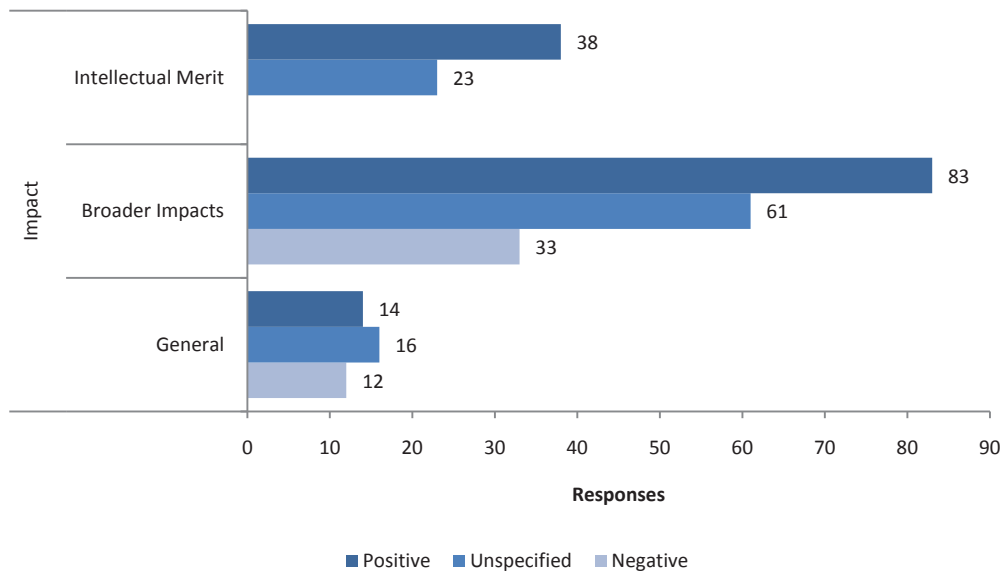
⁵ Percentages are calculated using the 88 respondents who commented on Intellectual Merit as the denominator.

something that I didn't think that I [could] convince myself and others of intellectual merit."

- The 79 respondents who commented on both the criteria in **general** were split between those who reported that the criteria had an **impact** on the development of their research (42, 53%) and those who said it had **no impact** (37, 47%).⁶

Responses were then coded to determine what type of impact the criteria had on the research projects. The impact was noted as positive, negative, or unspecified impact (Figure 17).

Figure 17. Was the impact of the criteria positive, unspecified, or negative? (Codes are not mutually exclusive; data represent 242 unique responses)



- Of the 177 respondents who commented on the Broader Impacts criterion, nearly half found the impact of the criterion on the development of their research projects to be positive (83 responses, 47%) and the others did not specify (61, 34%), or found it to be negative (33, 19%).

– An example of a positive response regarding Broader Impacts is:

“The Broader Impacts criterion had a major and positive impact on my research projects. Without this criterion I probably would not have considered major educational and outreach components to my research or ever thought about engaging in applied research.”

⁶ Percentages are calculated using the 79 respondents who commented on both of the criteria in general as the denominator.

- An example of a response indicating an unspecified impact regarding Broader Impacts is:

“It has certainly led me to put greater emphasis on planning activities such as undergraduate research experiences and others that focus on broader impact. I’m not sure whether this is a good thing or not (definitely the activities are good, but given budget caps, most expenditures on broader impact come at the expense of the core science).”

- An example of a negative response regarding Broader Impacts is:

“It has made me try to find collaborators with expertise in education. But, since my institution is limited in this regard and it is not an area in which I have expertise, it has not been time well spent.”

- Among the 61 responses (38, 62%) were positive about the impact of intellectual merit, several responses were unspecified (23, 38%), and no respondents reported a negative impact of that criterion on their research projects.⁷

- An example of a positive response regarding intellectual merit is:

“NSF’s very high standards in regard to intellectual merit has caused me to carefully consider, re-consider, and re-consider my proposed methodology – which is a very good thing. At each point of re-consideration, the methodology becomes more innovative and robust.”

- An example of a response indicating an unspecified impact regarding intellectual merit is:

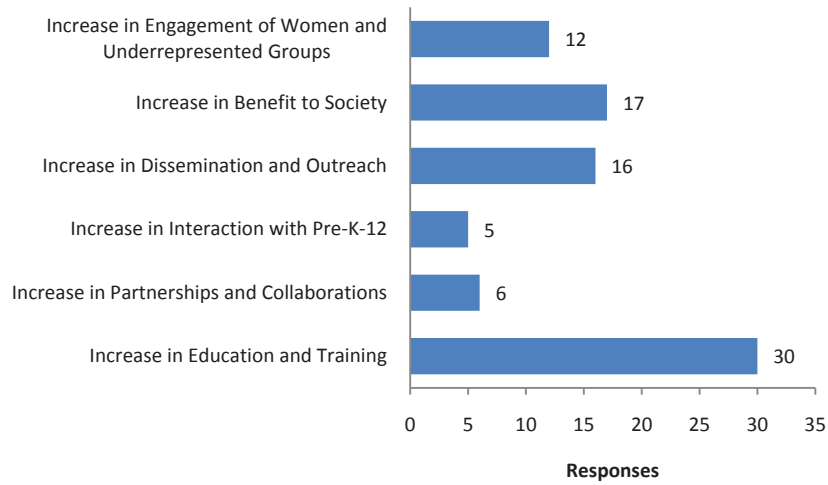
“The IM criteria makes me more focused on the research component of my mission as a scientist.”

- The remaining respondents who wrote about the criteria in general terms were relatively evenly split between reporting **positive** (14, 6%), **unspecified** (16, 7%) and **negative** (12, 5%) impacts.

The responses reporting that the Broader Impacts criterion had a positive impact were further categorized into the reasons for why the impact was positive (Figure 18).

⁷ Percentages were calculated using the 61 respondents who considered the impact of Intellectual Merit on the development of their research projects as the denominator.

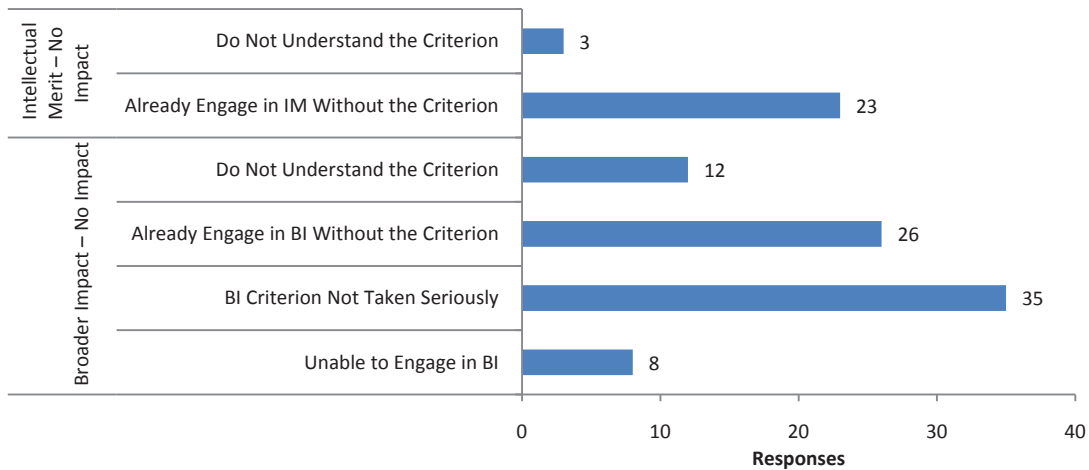
Figure 18. In what ways did the Broader Impacts criterion have a positive impact on respondents? (Codes are not mutually exclusive; data represent 83 unique responses)



The most common response indicated that the Broader Impacts criterion had a positive impact by increasing involvement in the **education and training of students** (30 responses, 36%). Seventeen respondents (20%) thought the criterion **increased the benefit to society**, while 16 responses (19%) said the criterion **increased the dissemination and outreach** of research to the public.

The responses reporting that Broader Impacts and Intellectual Merit criteria had no impact were further sorted by the reason given (Figure 19).

Figure 19. What were the reasons given for criteria having no impact? (BI-No Impact and IM-No Impact codes are not mutually exclusive; data represent 89 unique responses)



With respect to the 26 responses that indicated that Intellectual Merit had no impact:

- The majority of respondents (23 out of 26 responses) who reported that Intellectual Merit had no impact said it was because it was **not taken seriously**, i.e. they already developed their research plans based on Intellectual Merit principles.
- A smaller number of respondents (3) reported that they either **did not understand** the Intellectual Merit criterion or that the reviews of the Intellectual Merit section of their proposals were inconsistent.

With respect to the 81 responses that indicated that Broader Impacts had no impact:⁸

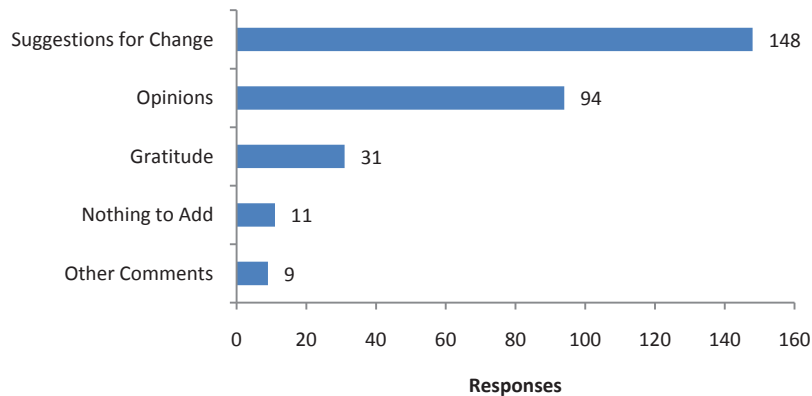
- A little less than one-half (35 responses, 43%) of the respondents reporting that Broader Impacts had no impact said it was because it was **not taken seriously**, i.e. they paid “lip service” to the criterion in their grant applications but it had no effect on how they performed their research projects.
- Approximately one-third (26, 32%) of those who said Broader Impacts had no impact stated **they already engaged in Broader Impacts activities** and would do so with or without the Broader Impacts criterion.
- The remaining respondents (20, 25%) either **did not understand** what Broader Impacts criterion entailed or found reviews of submitted proposals inconsistent leading them to be unsure how to apply the criteria to their research; or felt they were **unable** to engage in Broader Impacts activities either due to their scientific field or lack of funding.

⁸ In this section, the 81 responses that indicated that Broader Impacts had no impact on the development of research projects were used as the denominator in the calculation of percentages.

Question 5: Any other comments?

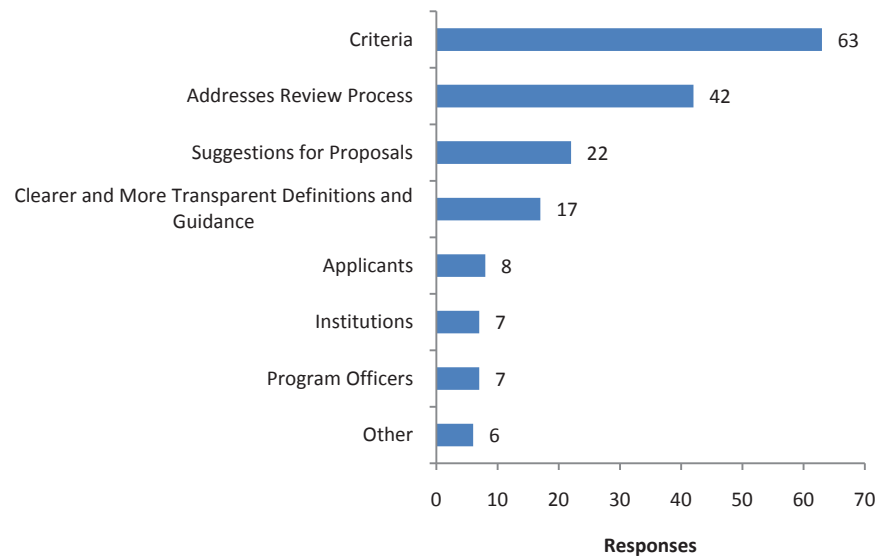
The 282 comments submitted for this question were coded into five different general categories: **Suggestions for Change**, **Opinions**, **Gratitude**, **Nothing to Add** and **Other** (Figure 20).

Figure 20. Any other comments?
(Codes are not mutually exclusive; data represent 282 unique responses)



The majority of comments (148 responses, 52%) provided suggestions for changing the criteria. These responses were coded further into seven additional sub-themes: **Criteria**, **Addresses Review Process**, **Suggestions for Proposals**, **Clearer and More Transparent Definitions and Guidance**, **Institutions**, **Applicants**, **Program Officers** and **Other**. On the whole, these suggestions were targeted at actions the NSF could undertake. Through aggregated samples from the responses, the three most salient suggestions (Figure 21) are discussed in detail below.

Figure 21. Themes for suggestions for change.
(Codes are not mutually exclusive; data represent 148 unique responses)



Address Review Process

These 42 comments (28%) focused primarily on the NSF review process and offered suggestions to improve it:

- Nine suggestions focused on encouraging NSF to adopt the review processes of the NIH or processes found in other countries
- Eight respondents suggested improving the re-review process either by asking the original reviewers to score the re-submitted proposal, or including reviewer comments from originally submitted proposals (either rejected or from pre-proposal phase) in the resubmission/next phase process
- Eight participants also made suggestions regarding how to improve scoring/ranking of proposals
- Seven suggestions centered on improving the efficiency and quality of the review process. To reduce burden, respondents suggested NSF could conduct “virtual reviews” using Skype or other electronic means, or mail-in reviews
- Seven participants thought reviewer selection needed improvement
- Three participants also suggested blinding the names and affiliations of the proposers to the reviewers

Suggestions for Proposals

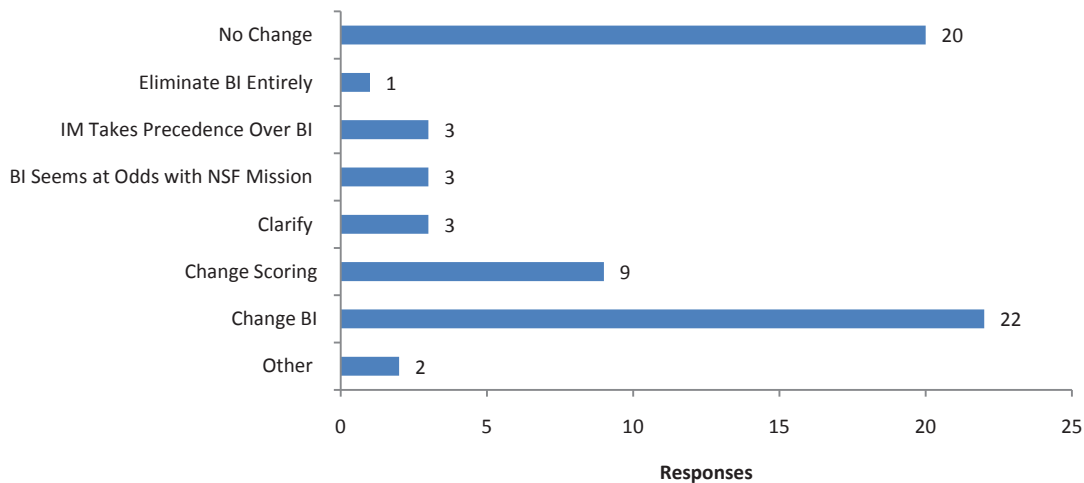
- Nine respondents suggested that NSF should restructure the proposal format by limiting the amount of information required and shortening the length of the proposal.
- Five other comments discussed the reallocation of funding. Some called for more proposals at a lower level of funding, or award smaller grant amounts more frequently to more investigators.
- Four respondents suggested having targeted calls for Broader Impacts instead of requiring it for every proposal.

Clearer and more transparent definitions and guidance

- Nine respondents suggested that the NSF needs to provide clearer definitions of their review criteria.
- Four respondents indicated that more guidance at the reviewer stage would improve the scoring/rating and may address divergence among reviewer scores.

The 63 responses that commented on the merit review criteria were coded further into themes. .

Figure 22. Criteria – detailed breakdown
(Codes are not mutually exclusive; data represent 63 unique responses)



Of the 63 comments with specific suggestions specifically regarding the criteria (Figure 22):

- Nearly one third (20 responses, 32%) respondents advocated that no changes should be made to the criteria.

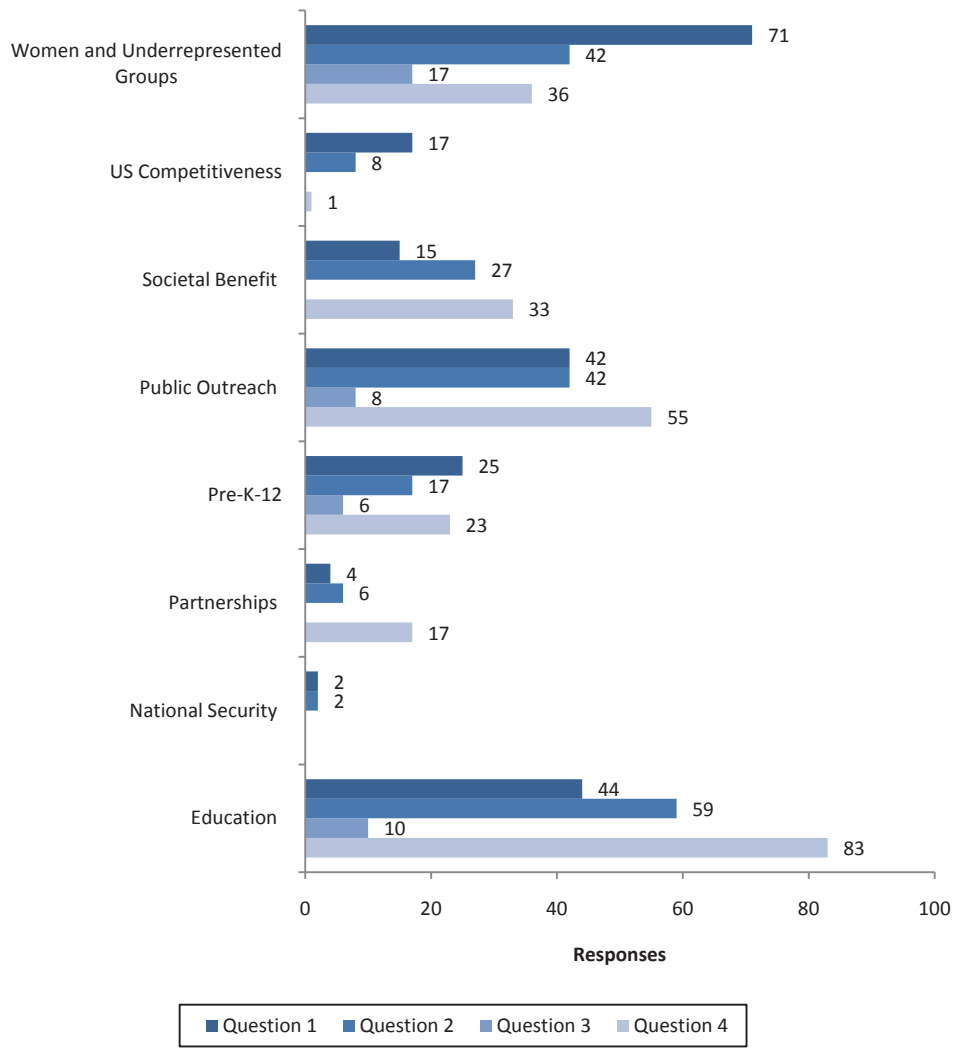
- Approximately one third (22, 35%) respondents suggested specifically changing the broader impacts criterion.
- Several respondents (9, 14%) suggested that changes could be made to the way proposals are scored. Similarly, three respondents (5%) reiterated recommendations seen in earlier questions, that greater clarity on the criteria would be helpful.

RFI Responses and the America COMPETES Reauthorization Act

In light of the America COMPETES Reauthorization Act of 2010, STPI counted each time a respondent mentioned a goal or activity associated with the broader impact criterion (Figure 23) across each of the first four survey questions. The categories were picked to include both representative activities included under existing NSF broader impact criterion and the newly established COMPETES goals (Sec. 526(a)(1)-(8)).

Across the four questions, the most common goals and activities were inclusion of women and underrepresented groups; education and training; and public outreach. Pre-K-12 focused activities and societal benefits were in the second tier, U.S. competitiveness and partnerships in the third tier, and national security was lowest, with only four mentions across all the responses to the first four questions.

Figure 23. How do the responses to questions 1 through 4 relate to the goals and activities of Broader Impacts criterion?



Conclusion

Although the bulk of STPI’s analysis focuses on respondents’ answers to the specific questions, the following general attitudes emerged:

- Satisfaction with the Intellectual Merit criterion.
- Appreciation of the conceptual value of the Broader Impacts criterion.
- Frustration with the implementation of the Broader Impacts criterion.
- Dissatisfaction with processes surrounding proposal reviews.

In general, respondents paid far more attention to the Broader Impacts criterion than to the Intellectual Merit criterion in their responses across the RFI.

Appendix E

Analysis of COV reports

Analysis of Committee of Visitor (COV) Reports to Identify Trends in Merit Review Criteria

Anthony D. Cak (BIO/OAD)

Introduction

- Because each program at the NSF is reviewed by a Committee of Visitors (COV) every three years, analysis of COV reports could provide a basic understanding of how merit review criteria are applied throughout the NSF through time.
- **Goal: To identify descriptive and temporal trends in merit review criteria.**
- **Specific Research Questions:**
 - 1) How often are Broader Impacts (BI) and Intellectual Merit (IM) mentioned in the COV reports?
 - 2) Are there any differences in the number of times BI and IM are mentioned among Directorates?
 - 3) Are there any differences in the number of times BI and IM are mentioned through time?
 - 4) Are there any differences in the number of times BI and IM are mentioned among Directorates through time?

Methods

- Analyze **195 COV Committee reports** from all Directorates for the period 2001-2009 (Table 1), together with data from two previous reports:
 - Bronstein, M. 2007. Analysis of committee of visitors (COV) reports: 2004-2007. Report generated for the National Science Foundation (NSF).
 - Haworth, W. L. 2009. Annual report on COVs. Memorandum to the Office of Integrative Activities (OIA) of the National Science Foundation (NSF).
- To assess the number of times Broader Impacts and Intellectual Merit are mentioned in the COV reports:
 - **Broader Impacts:** Use open-source text analytical software (DocFetcher 1.0.3, <http://docfetcher.sourceforge.net/en/index.html>) to identify the frequency of the following words: Broader Impacts, Broaden Participation, Broadening Participation, Criterion 2
 - **Intellectual Merit:** Use open-source text analytical software (DocFetcher 1.0.3, <http://docfetcher.sourceforge.net/en/index.html>) to identify the frequency of the following words: Intellectual Merit, Scientific Merit, Criterion 1
- Qualitative data coded into categories for analysis (Table 2).

COV Report Analysis for Merit Review Criteria

A.D. Cak

Results

Figure 1. Number of times the words “Broader Impacts” and “Intellectual Merit” appear in COV reports for the period 2000-2009, by Directorate (columns). Also shown is the frequency of these words per page (i.e., the number of times the words appear for each document divided by that document’s total page number), as lines.

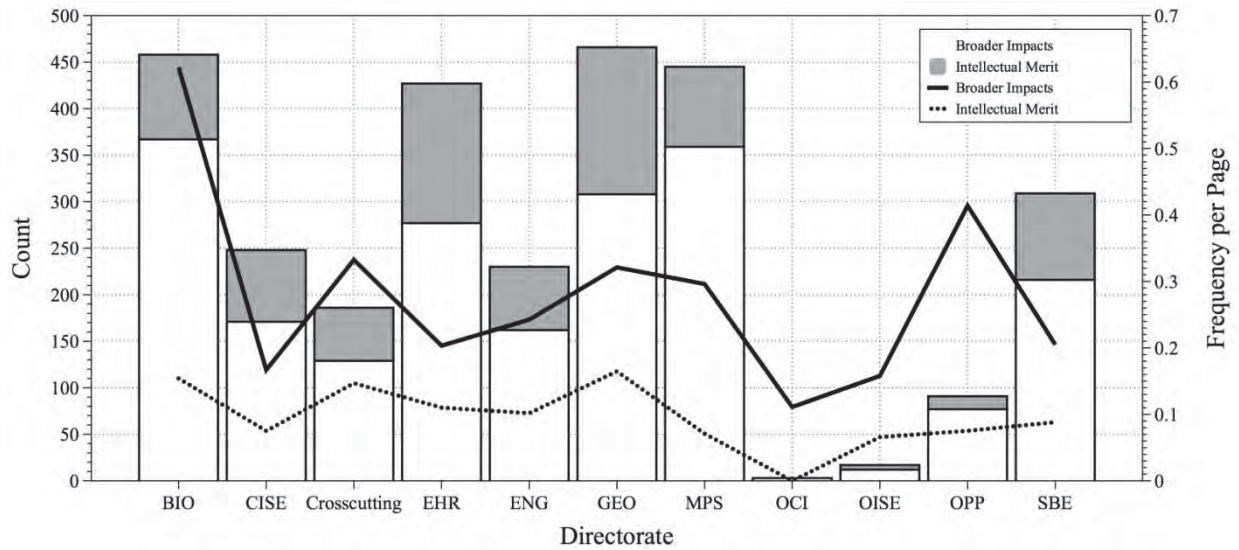
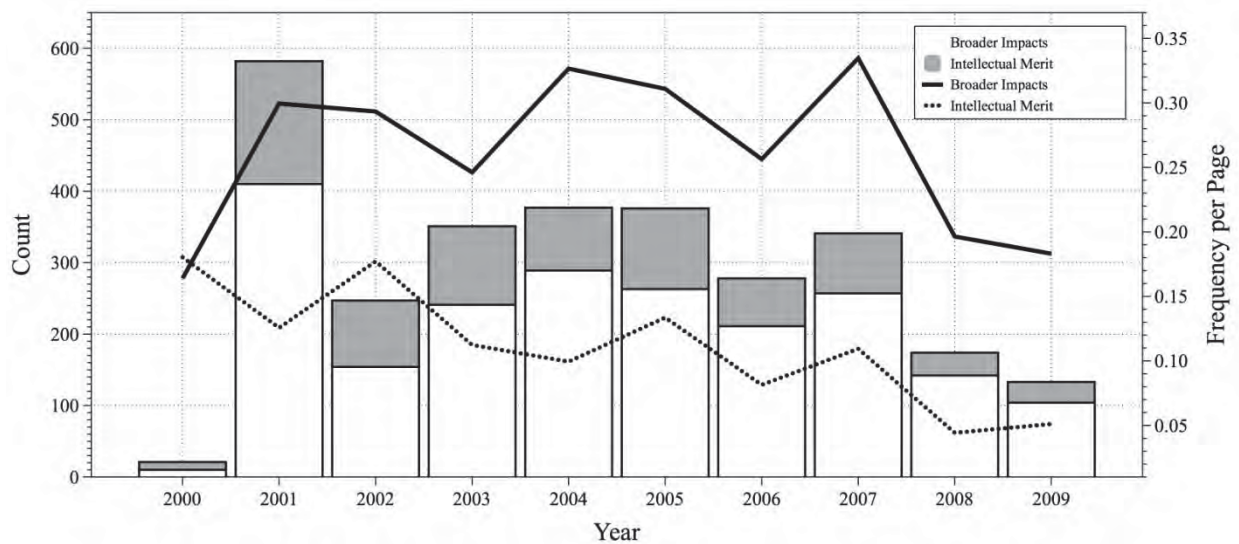


Figure 2. Number of times the words “Broader Impacts” and “Intellectual Merit” appear in COV reports for all Directorates, by COV report year (columns). Also shown is the frequency of these words per page (i.e., the number of times the words appear for each document divided by that document’s total page number), as lines.



COV Report Analysis for Merit Review Criteria

A.D. Cak

Figure 3. Number of times the words “Broader Impacts” (Black Bar) and “Intellectual Merit” (Gray Bar) appear in COV reports, by Directorate and COV report year.

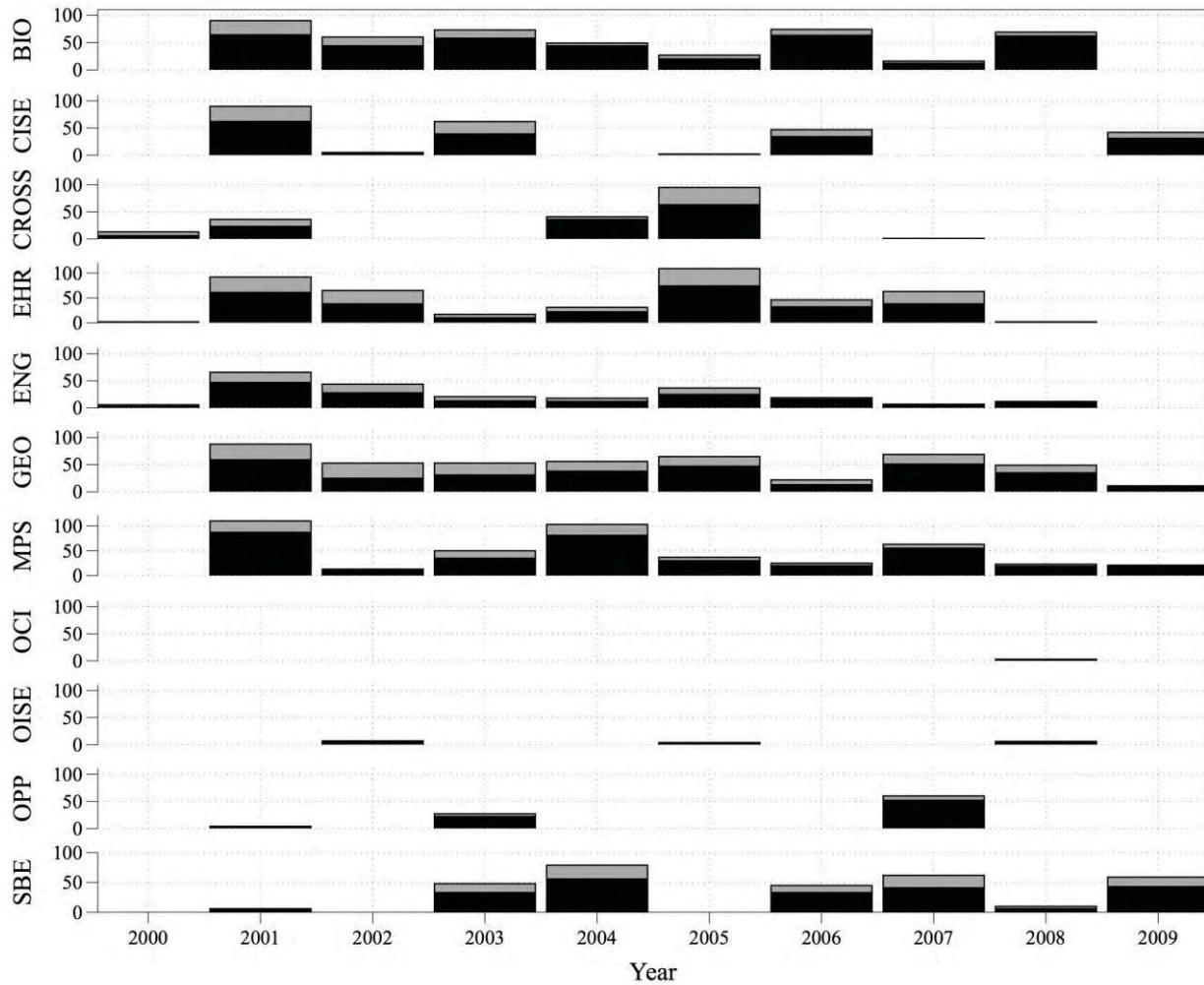


Table 1. Number of COV reports analyzed, by Directorate and COV report year.

Directorate	Year										Total
	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	
BIO		5	4	4	2	2	2	2	2		23
CISE		4	2	3		1	3			3	16
CROSS	1	3			2	3		1			10
EHR	1	6	5	8	7	12	6	4	6		55
ENG	1	5	2	2	3	2	2	2	1	1	21
GEO		4	3	3	2	4	2	3	4	2	27
MPS		4	2	2	2	2	1	2	2	1	18
OCI									1		1
OISE			1			1			1		3
OPP		3		1	1			2			7
SBE		2		2	3		2	1	1	3	14
Total	3	36	19	25	22	27	18	17	18	10	195

COV Report Analysis for Merit Review Criteria

A.D. Cak

Table 2. Description of context in which Broader Impacts was mentioned in the COV report text.

Context	Description
Broader Impacts Description/Definition	
Generally Mentioned	Generally noted in the text, usually in introductory remarks
Fundamental for Program	BI was a fundamental element for the success of Division programs
Well Specified	Criteria and definition of BI was well regarded and noted in the review process
Needs Better Specification	Criteria and definition of BI needed more explanation and possible revision due to confusion
Suggestions for Review Structure	
Generally Noted	Generally noted in the text, usually in introductory remarks
More Outreach Needed	More outreach was needed by NSF to clarify BI and for research to have a greater impact
More Education or Examples Needed	More education or examples need to be provided to PI's and reviewers to increase understanding of BI criterion
COV Report Organizational Change	Review structure needs alteration to emphasize BI criterion (i.e., encourage specific sections in FastLane for BI analysis)
Better Tracking Method	Better system of tracking how PI's are addressing BI in proposals, and to what impacts research is having on society
Application of BI in Review	
Generally Mentioned	Generally noted in the text, usually in introductory remarks
Abundant Attention	BI was frequently given attention in the review process (by NSF Staff and PI's) and was an integral component in review
Some Attention	BI was sometimes mentioned in the review process
Little Attention	BI was given little attention in the review process
Inconsistent Application of Criteria	BI criterion was not consistently applied in the review process (i.e., between Program Officers, panel summaries, and individual reviewers) and was often not given as much credence as Intellectual Merit in the review analysis
Notable Improvement in Application	There was a notable improvement (i.e., frequency and emphasis) in the use of the BI criterion in the review process

COV Report Analysis for Merit Review Criteria

A.D. Cak

Table 3. Context (i.e., type of sentence or paragraph) in which each time the words ‘Broader Impacts’ are mentioned in the COV reports, by COV report year.

BI Context	Year										Total
	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	
Broader Impacts Description/Definition											
Generally Mentioned	0	41	1	5	16	10	7	13	3	7	103
Fundamental for Program	1	21	3	28	28	21	24	24	13	19	182
Well Specified	0	0	1	3	4	2	1	0	1	0	12
Needs Better Specification	0	32	12	17	22	30	27	28	9	15	192
Suggestions for Review Structure											
Generally Mentioned	0	2	0	0	6	1	1	1	0	1	12
More Outreach Needed	0	3	3	1	6	4	6	8	5	2	38
More Education or Examples Needed	0	44	20	38	50	39	32	47	18	21	309
COV Report Organizational Change	1	7	7	6	6	2	2	5	2	1	39
Better Tracking Method	0	15	1	3	7	10	10	13	12	3	74
Application of BI in Review											
Generally Mentioned	0	5	2	0	1	0	1	2	1	1	13
Abundant Attention	1	70	38	23	29	20	21	32	33	17	284
Some Attention	1	41	23	32	29	27	25	11	11	10	210
Little Attention	3	58	19	28	17	24	13	23	7	4	196
Inconsistent App. of Criteria	2	48	27	34	40	60	35	42	20	13	321
Notable Improvement in Application	1	23	9	23	28	13	6	8	7	1	119
Total	10	410	166	241	289	263	211	257	142	115	2,104

COV Report Analysis for Merit Review Criteria

A.D. Cak

Table 4. Context (i.e., type of sentence or paragraph) in which each time the words ‘Broader Impacts’ are mentioned in the COV reports, by Directorate.

BI Context	Directorate											Total
	BIO	CISE	CROSS	EHR	ENG	GEO	MPS	OCI	OISE	OPP	SBE	
Broader Impacts Description/Definition												
Generally Mentioned	15	31	7	14	3	10	1	0	0	6	7	94
Fundamental for Program	33	18	12	34	5	21	35	0	0	7	16	181
Well Specified	3	2	0	1	0	1	2	0	0	0	5	14
Needs Better Specification	26	6	21	20	30	0	32	1	1	12	23	172
Suggestions for Review Structure												
Generally Noted	2	0	0	0	0	4	0	0	0	0	0	6
More Outreach Needed	10	4	1	9	1	23	6	0	1	2	3	60
More Education or Examples Needed	50	33	2	41	31	46	43	0	4	11	41	302
Report Organizational Change	12	1	3	5	3	5	13	0	0	2	1	45
Better Tracking Method	29	3	0	16	6	3	8	0	0	6	4	75
Application of Broader Impacts in Review												
Generally Mentioned	1	0	0	0	0	2	5	0	0	0	0	8
Abundant Attention	42	22	21	45	16	45	58	2	2	5	39	297
Some Attention	59	25	14	31	11	23	29	0	2	14	14	222
Little Attention	44	14	11	19	23	24	36	0	0	5	20	196
Inconsistent App. of Criteria	19	18	33	31	35	79	62	0	0	0	33	310
Notable Improvement in Application	18	3	4	11	8	27	32	0	2	7	10	122
Total	363	180	129	277	172	313	362	3	12	77	216	2,104

COV Report Analysis for Merit Review Criteria

A.D. Cak

Discussion

- Broader Impacts (BI) mentioned more frequently than Intellectual Merit (IM) across all Directorates and through time (Figures 1-3)
- BI and IM mentioned more often in larger Directorates, such as BIO (Figures 1, 2)
 - Interesting to note: OPP had a higher BI frequency per page (i.e., how often it is mentioned in the COV Reports) than other Directorates
- Broader Impacts and Intellectual Merit mentioned most frequently for COV reports in 2001, generally declining in subsequent COV report years (Figures 1-3)
 - Frequency per page has declined, but at a slower rate than the total word count)
- BI most commonly mentioned in the following context (Tables 3, 4):
 - BI was a fundamental element for Divisions, Programs, and Solicitations
 - Better specification of BI criteria is needed in its definition by NSF
 - Generally noted across most Directorates and among all COV report years
 - More education or examples of BI in the review process, such as for PI's and reviewers
 - Generally noted across most Directorates and among all COV report years
 - Better method of tracking the impacts of research
 - Particularly noted by BIO, generally noted among all COV report years
 - In review, BI mentioned when it was given abundant attention by NSF Staff and PI's in reviews, some attention by NSF Staff and PI's in reviews, and little attention by NSF Staff and PI's in reviews
 - Generally noted across most Directorates and among all COV report years
 - BI most often mentioned when COV committees noted that it was applied inconsistently in the following situations: 1) differences in application between Program Officer reviews, panel summaries, and individual reviews, and 2) differences in assessment between BI and IM (i.e., greater emphasis usually placed on IM over BI)
 - Noted most frequently by GEO and MPS

Appendix F

Topic Modeling and Analysis of NSF's Broader Impacts Criterion

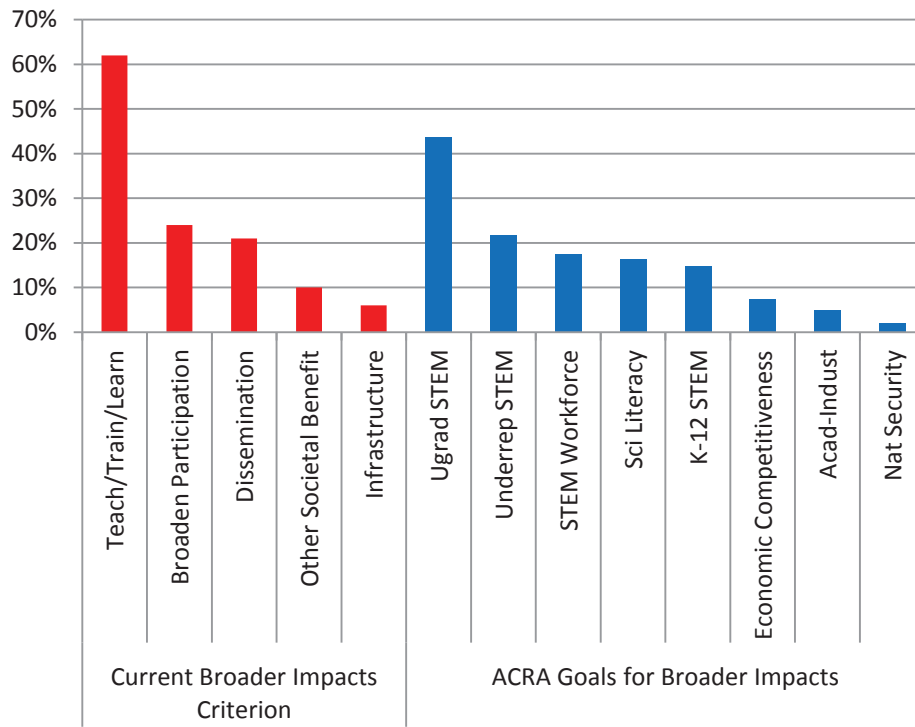
Topic Modeling of Broader Impacts in NSF Proposals

As part of the work of the NSB Task Force on Merit Review, there was particular interest in understanding how the Broader Impacts review criterion was being interpreted. Dr. David Newman (University of California Irvine and TopicSeek, Inc.) had previously developed a topic modeling tool for the purpose of analyzing NSF grant proposals (the development of which had been supported by NSF). Through the application of topic modeling techniques, the Task Force on Merit Review hoped to learn how Principal Investigators (PIs) defined Broader Impacts in their NSF proposals. The NSB issued a contract to David Newman at TopicSeek, Inc., in spring 2011, for this analysis.

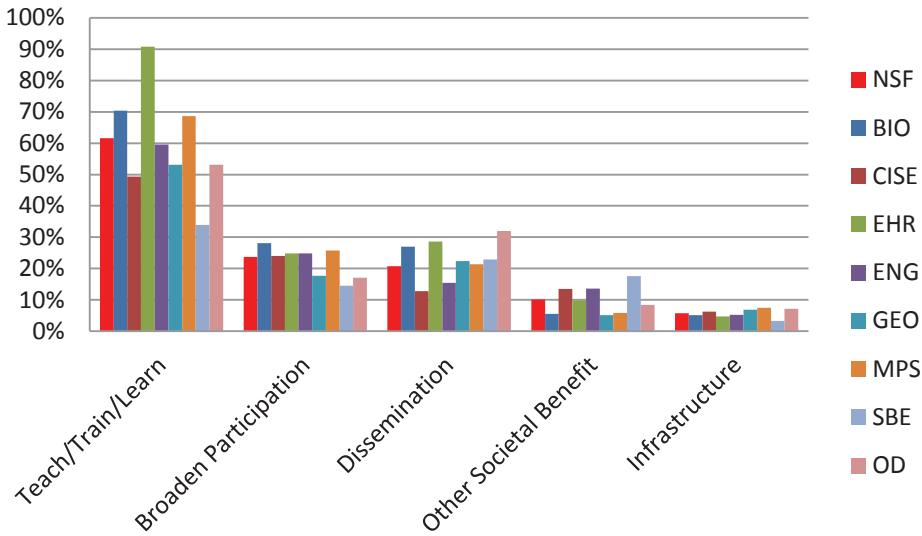
The topic model is considered the state-of-the-art algorithm for extracting semantic structure from text collections, to allow the automatic learning of a set of topics. For the purpose of this analysis, the project summaries of ~150,000 NSF proposals housed in the NORC Data Enclave were analyzed first for the presence of the term “Broader Impacts.” Approximately 100,000 proposals contained this exact phrase; these proposals formed the database for all subsequent analyses. Topic modeling was then done by analyzing the 200 words immediately following the phrase “Broader Impacts,” which generated a list of 100 learned topics. NSF staff categorized the top 70 learned topics first against the current five potential Broader Impacts considerations (integration of research and education, broadening participation, enhancement of infrastructure, broad dissemination, societal benefit), and then separately against the eight Broader Impacts goals proposed in the America COMPETES Reauthorization Act of 2010 (.

The topic modeling data were then analyzed to quantify the types of Broader Impacts described in NSF proposals overall, in proposals submitted to different Directorates, and in awards vs. declines. The results for the first two analyses are shown on the following pages. The analysis of awards vs. declines did not show meaningful differences.

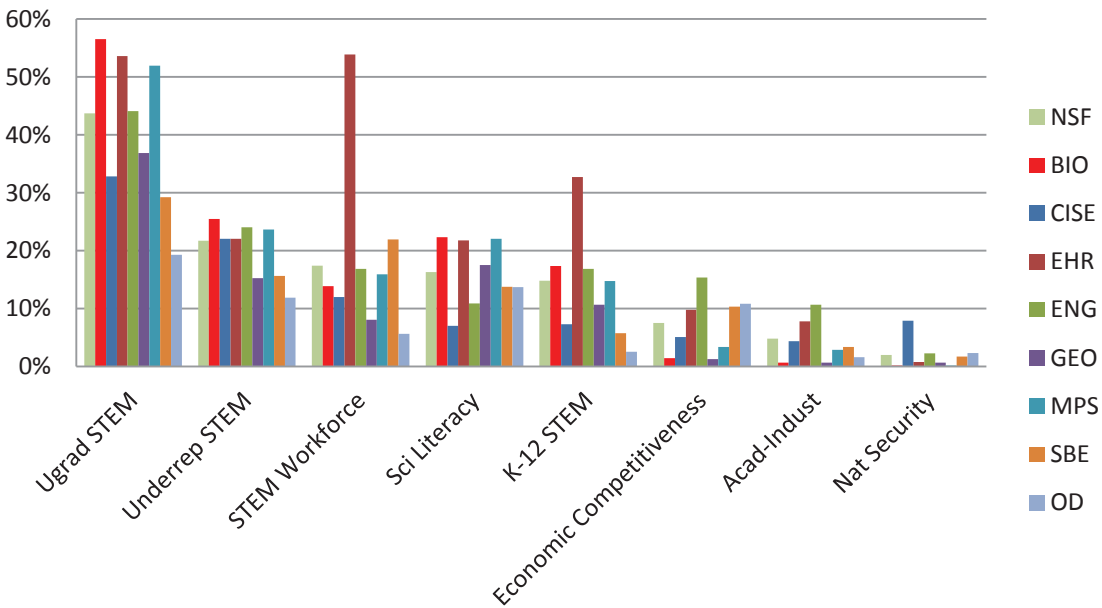
Types of Broader Impacts in NSF Proposals



Broader Impacts by Directorate Current Criterion



Broader Impacts by Directorate ACRA Goals



Appendix G

First Revision of the Criteria

NSB-11-42

NSB/NSF Seeks Input on Proposed Merit Review Criteria Revision and Principles

National Science Board
June 14, 2011

Over the past year, the National Science Board (NSB) has been conducting a review of the National Science Foundation's merit review criteria (Intellectual Merit and Broader Impacts). At the Board's May 2011 meeting, the NSB Task Force on Merit Review proposed a revision of the two merit review criteria, clarifying their intent and how they are to be used in the review process. In addition, the Task Force identified a set of important underlying principles upon which the merit review criteria should be based. We now seek your input on the proposed revision and principles.

The Task Force looked at several sources of data for information about how the criteria are being interpreted and used by the NSF community, including an analysis of over 190 reports from Committees of Visitors. The Task Force also reached out to a wide range of stakeholders, both inside and outside of NSF, to understand their perspectives on the current criteria. Members of NSF's senior leadership and representatives of a small set of diverse institutions were interviewed; surveys about the criteria were administered to NSF's program officers, division directors, and advisory committee members and to a sample of 8,000 of NSF's Principal Investigators (PIs) and reviewers; and the NSF community at large was invited to provide comments and suggestions for improvements through the NSF web site (http://www.nsf.gov/nsb/publications/2011/01_19_mrtf.jsp). The stakeholder responses were very robust—all told, the Task Force considered input from over 5,100 individuals.

One of the most striking observations that emerged from the data analyses was the consistency of the results, regardless of the perspective. All of the stakeholder groups identified similar issues, and often offered similar suggestions for improvements. It became clear that the two review criteria of Intellectual Merit and Broader Impacts are in fact the right criteria for evaluating NSF proposals, but that revisions are needed to clarify the intent of the criteria, and to highlight the connection to NSF's core principles.

The two draft revised criteria, and the principles upon which they are based, are below. Comments are being collected through July 14—we invite you to send comments to meritreview@nsf.gov. It is expected that NSF will develop specific guidance for PIs, reviewers, and NSF staff on the use of these criteria after the drafts are finalized. Your comments will help inform development of that guidance, and other supporting documents such as FAQs.

The Foundation is the primary Federal agency supporting research at the frontiers of knowledge, across all fields of science and engineering (S&E) and at all levels of S&E education. Its mission, vision and goals are designed to maintain and strengthen the vitality of the U.S. science and engineering enterprise and to ensure that Americans benefit fully from the products of the science, engineering and education activities that NSF supports. The merit review process is at the heart of NSF's mission, and the merit review criteria form the critical base for that process.

We do hope that you will share your thoughts with us. Thank you for your participation.

Ray M. Bowen
Chairman, National Science Board

Subra Suresh
Director, National Science Foundation

Merit Review Principles and Criteria

The identification and description of the merit review criteria are firmly grounded in the following principles:

1. All NSF projects should be of the highest intellectual merit with the potential to advance the frontiers of knowledge.
2. Collectively, NSF projects should help to advance a broad set of important national goals, including:
 - Increased economic competitiveness of the United States.
 - Development of a globally competitive STEM workforce.
 - Increased participation of women, persons with disabilities, and underrepresented minorities in STEM.
 - Increased partnerships between academia and industry.
 - Improved pre-K–12 STEM education and teacher development.
 - Improved undergraduate STEM education.
 - Increased public scientific literacy and public engagement with science and technology.
 - Increased national security.
 - Enhanced infrastructure for research and education, including facilities, instrumentation, networks and partnerships.
3. Broader impacts may be achieved through the research itself, through activities that are directly related to specific research projects, or through activities that are supported by the project but ancillary to the research. All are valuable approaches for advancing important national goals.
4. Ongoing application of these criteria should be subject to appropriate assessment developed using reasonable metrics over a period of time.

Intellectual merit of the proposed activity

The goal of this review criterion is to assess the degree to which the proposed activities will advance the frontiers of knowledge. Elements to consider in the review are:

1. What role does the proposed activity play in advancing knowledge and understanding within its own field or across different fields?
2. To what extent does the proposed activity suggest and explore creative, original, or potentially transformative concepts?
3. How well conceived and organized is the proposed activity?
4. How well qualified is the individual or team to conduct the proposed research?
5. Is there sufficient access to resources?

Broader impacts of the proposed activity

The purpose of this review criterion is to ensure the consideration of how the proposed project advances a national goal(s). Elements to consider in the review are:

1. Which national goal (or goals) is (or are) addressed in this proposal? Has the PI presented a compelling description of how the project or the PI will advance that goal(s)?
2. Is there a well-reasoned plan for the proposed activities, including, if appropriate, department-level or institutional engagement?
3. Is the rationale for choosing the approach well-justified? Have any innovations been incorporated?
4. How well qualified is the individual, team, or institution to carry out the proposed broader impacts activities?
5. Are there adequate resources available to the PI or institution to carry out the proposed activities?

Appendix H

STPI Summary Report of Responses to First Revision of the Criteria



MEMORANDUM

September 7, 2011

To: Kim Silverman, National Science Board Office (NSBO), Joanne Tornow, National Science Foundation (NSF)

From: Rachel Parker, Science and Technology Policy Institute (STPI), Susannah Howieson, STPI

CC: Sallie Keller, STPI

Subject: Merit Review Task Force: Dear Colleague Letter Analysis and Findings

The National Science Board Office (NSBO) asked the IDA Science and Technology Policy Institute (STPI) to provide an analysis of responses to an open Dear Colleague Letter, requesting feedback related to proposed changes to the Merit Review Criteria of the National Science Foundation (NSF).

STPI coded and analyzed the responses using content analytic methods to refine the key themes emergent throughout the data. The data reveal trends that may provide support to the Merit Review Task Force, the larger Board, and the National Science Foundation more broadly.

Attachments: “Merit Review Task Force: Dear Colleague Letter Analysis and Findings”
“Appendix: Suggestions for Wording, Format or Organizational Change”

Merit Review Task Force: Dear Colleague Letter Analysis and Findings

Susannah Howieson

Daniel Basco

Rachel Parker, *Task Leader*

September 7, 2011

Executive Summary

The June 14, 2011 Dear Colleague Letter (NSB-11-42) solicited by the National Science Board's Task Force on Merit Review Criteria resulted in 278 unique responses from which the IDA Science and Technology Policy Institute (STPI) derived the findings presented here.

Over two-thirds of the respondents were from universities, and the majority of those were individual professors. Responses to the Dear Colleague Letter were generally mixed, neither overwhelmingly positive nor negative. Respondents commented on the national goals, revised Broader Impacts and Intellectual Merit criteria, and implementation, and provided suggestions for wording, format and organizational changes.

Most of those who commented on national goals felt that the list was missing key priority areas for the country. Respondents suggested the list be expanded to include several additional national priorities. The top two most prevalent themes to emerge for inclusion in the list of national goals were social welfare and human health; and environment and energy. A number of respondents also expressed dissatisfaction with the listing and content of the national goals; a few respondents stated they were satisfied with the national goals. Additional respondents reported the revised criteria had diluted the emphasis on the core mission of NSF.

The majority of responses related to the revised Broader Impacts criterion reported that the attention paid to increasing diversity and broadening participation was weaker in the proposed revision. Additional respondents stated that in their view, the draft revision limited the potential impact of NSF-funded research. Some respondents reported that in their view, the draft revision hindered PIs' ability to focus on the development of STEM education and the STEM workforce – independent of broadening participation. Some respondents raised issues related to the content of the elements under the Broader Impacts criterion.

While fewer in number than comments on the Broader Impacts criterion, the majority of responses which discussed the Intellectual Merit criterion were generally positive. Though respondents were directed to comment on the content of the criteria, a number discussed implementation. Most of the comments on implementation dealt with issues related to evaluation or metrics and the review process. Others discussed the proper role of the institution and recommended there be funding provided for broader impacts activities.

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Introduction

The National Science Board Office (NSBO) asked the IDA Science and Technology Policy Institute (STPI) to provide an analysis of responses to an open Dear Colleague Letter (NSB-11-42) from June 14, 2011 related to proposed changes to the merit review criteria of the National Science Foundation. The draft revised criteria upon which the public was asked to respond are:

“Merit Review Principles and Criteria

The identification and description of the merit review criteria are firmly grounded in the following principles:

1. All NSF projects should be of the highest intellectual merit with the potential to advance the frontiers of knowledge.
2. Collectively, NSF projects should help to advance a broad set of important national goals, including:
 - Increased economic competitiveness of the United States.
 - Development of a globally competitive STEM workforce.
 - Increased participation of women, persons with disabilities, and underrepresented minorities in STEM.
 - Increased partnerships between academia and industry.
 - Improved pre-K–12 STEM education and teacher development.
 - Improved undergraduate STEM education.
 - Increased public scientific literacy and public engagement with science and technology.
 - Increased national security.
 - Enhanced infrastructure for research and education, including facilities, instrumentation, networks and partnerships.
3. Broader impacts may be achieved through the research itself, through activities that are directly related to specific research projects, or through activities that are supported by the project but ancillary to the research. All are valuable approaches for advancing important national goals.
4. Ongoing application of these criteria should be subject to appropriate assessment developed using reasonable metrics over a period of time.

Intellectual merit of the proposed activity

The goal of this review criterion is to assess the degree to which the proposed activities will advance the frontiers of knowledge. Elements to consider in the review are:

1. What role does the proposed activity play in advancing knowledge and understanding within its own field or across different fields?
2. To what extent does the proposed activity suggest and explore creative, original, or potentially transformative concepts?
3. How well conceived and organized is the proposed activity?
4. How well qualified is the individual or team to conduct the proposed research?
5. Is there sufficient access to resources?

Broader impacts of the proposed activity

The purpose of this review criterion is to ensure the consideration of how the proposed project advances a national goal(s). Elements to consider in the review are:

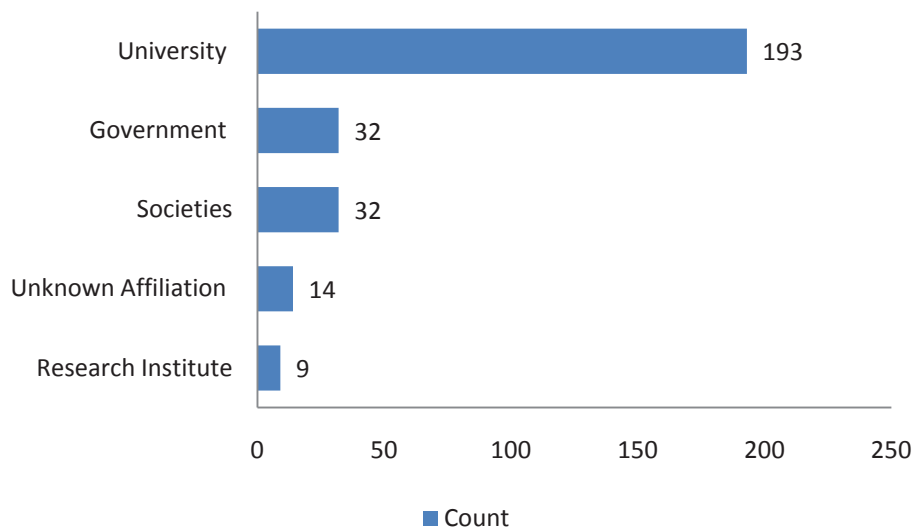
1. Which national goal (or goals) is (or are) addressed in this proposal? Has the PI presented a compelling description of how the project or the PI will advance that goal(s)?
2. Is there a well-reasoned plan for the proposed activities, including, if appropriate, department-level or institutional engagement?
3. Is the rationale for choosing the approach well-justified? Have any innovations been incorporated?
4. How well qualified is the individual, team, or institution to carry out the proposed broader impacts activities?
5. Are there adequate resources available to the PI or institution to carry out the proposed activities?" (NSB-11-42).

STPI conducted this analysis using content analytic methods to inductively code and classify the data according to the themes present throughout the responses. STPI analyzed the responses iteratively, building nuance into the understanding of the responses. Data were grouped according to emergent themes to allow for more detailed analysis. Codes were applied to each individual response allowing the data to be refined, and the nuances drawn out. In some instances, it is possible for one respondent to have discussed several themes throughout one response. In such cases, to fully understand the nuances of the respondent's answer to a question, more than one code was applied. Numbers of unique responses, and whether the codes applied were mutually exclusive or not, are included for each figure to reinforce this point.

Basic Demographics of Respondents

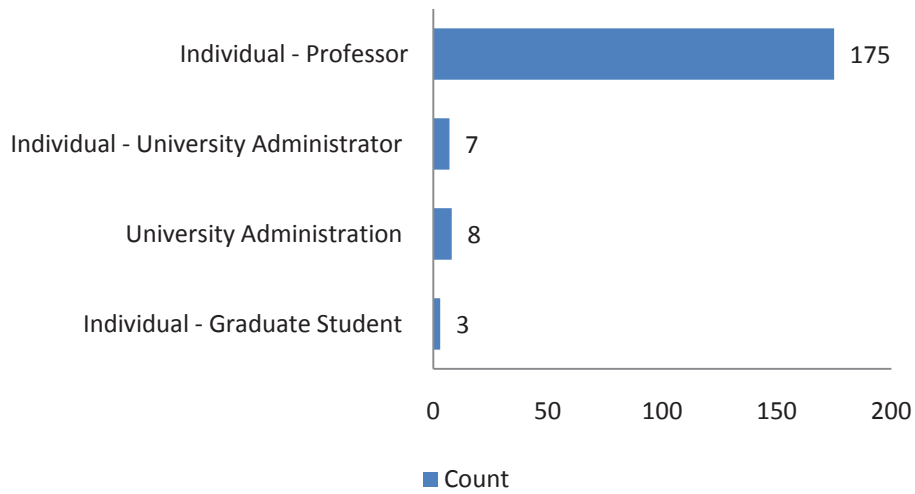
There were 278 unique respondents to the Dear Colleague Letter. The majority of respondents were from universities (193) (Figure 1). Thirty-two respondents work for the government at a Federal agency. A total of 32 letters were submitted on behalf of organizations, representing their formal positions. These included 13 scientific professional societies and 19 other NGOs and advocacy groups. Nine responses came from persons affiliated with research institutes and 14 respondents provided no affiliation.

Figure 1. Responses by Type of Institution



With regard to the composition of the 193 respondents from universities, the majority of responses came from individual professors (Figure 2). The remaining responses were divided amongst individual university administrators writing on their own behalf, university administrators writing on behalf of the university, and graduate students.

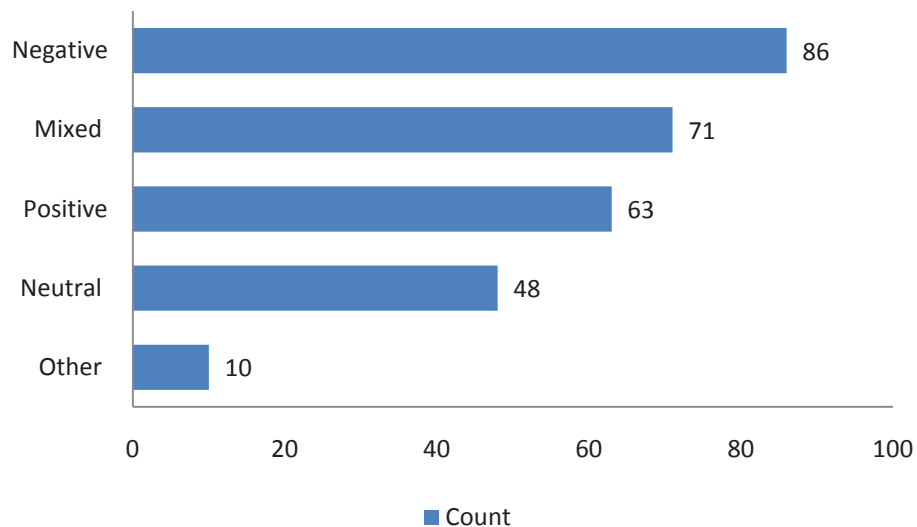
Figure 2. University Respondents by Type



There were no issues specific or unique to any one type of respondent, including letters written on behalf of organizations. From this point on, the focus of this analysis is on the responses as a group.

In general, respondents' attitudes toward the draft revised criteria were mixed – presenting both positive and negative feedback (Figure 3). Sixty-four respondents made positive comments with regard to the proposed changes, while 86 respondents provided negative feedback on the proposed revision. An additional 71 respondents reported a mixed opinion (both positive and negative), while 48 respondents were neutral toward the draft revision.

Figure 3. Valence of Responses (278 unique respondents)



Approximately one-third of respondents (87) expressed some level of appreciation for the draft revised criteria. These respondents were divided between two categories: 18 respondents were pleased or satisfied with the revisions as is, and 69 respondents thought the new version was an improvement but had comments or suggestions for possible additional changes.

- An example of a response expressing such a comment:

“The refinement of these criteria is an admirable step towards clarifying exactly what the NSF is talking about in its prompts. The drawback is that this list looks suspiciously like a course catalog of buzzwords to hit in one’s FRFP application.”

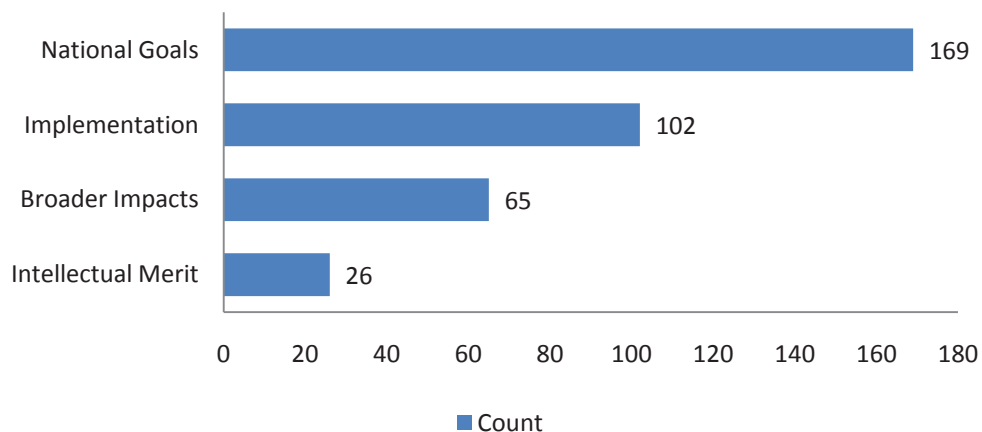
- An example of a respondent satisfied with the revised criteria in their current form:

“I LOVE this rewrite!!! The bullets are especially good, making it easier to read and understand at a glance. The preamble is excellent and succinct and I feel really gets the point across. I am tired of people giving me intellectual merit goals as broader impacts. This make that completely clear and also makes clear that we do not insist that they do this for free, but have “adequate resources” to carry out their plan.

Kudos to whoever drafted this document.”

Responses were categorized by which section of the revised criteria they commented on: national goals, implementation, Broader Impacts criterion and Intellectual Merit criterion (Figure 4). Some respondents discussed more than one section.

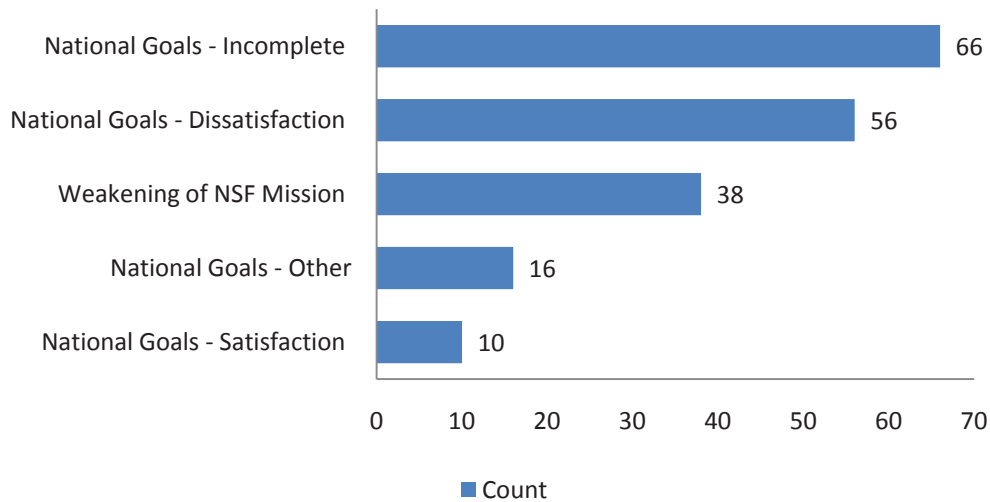
Figure 4. Responses by Section of Criteria (Codes are not mutually exclusive, data represent 278 unique responses)



Attitudes toward National Goals

There were 169 comments on the list of national goals provided in the merit review criteria (Figure 5). Of those, the most common responses indicated that the list is incomplete and reported feeling dissatisfied with the listing of national goals. Additional respondents stated they were satisfied with the current content and format of the list; and others commented that the draft revision diluted the mission of the National Science Foundation in supporting basic research.

Figure 5. Attitudes toward National Goals in Merit Review Criteria (Codes are not mutually exclusive; data represent 169 unique respondents)



- Fifty-six responses expressed dissatisfaction with the listing and content of the national goals, and 10 expressed satisfaction.

- Two examples of responses expressing dissatisfaction with the national goals:

“In fact, providing a list at all is potentially divisive and counterproductive.”

“The proposed national goals appear to pigeonhole the NSF almost exclusively as a support arm for commercial enterprise and a public relations firm for scientific literacy.”

- An example of a respondent satisfied with the national goals:

“It is encouraging to see more explicit guidelines outlining the kinds of things that would fall under the broad category of ‘broader impacts.’”

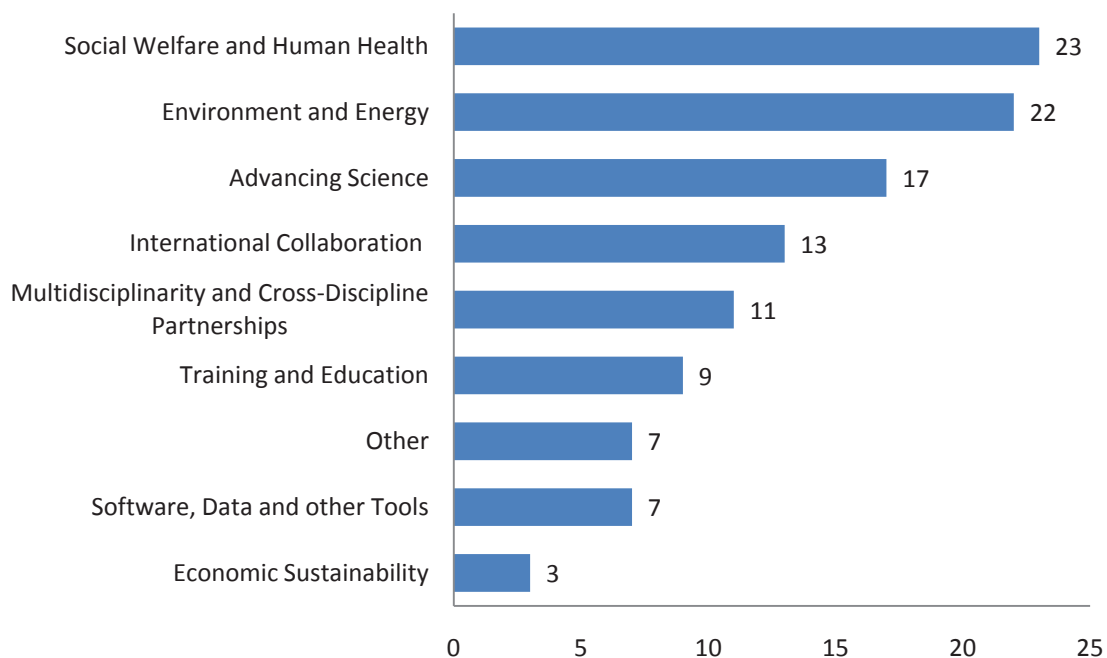
- Thirty-eight respondents commented that the draft revision diluted the mission of the National Science Foundation in supporting basic research.

- An example of a response that the revised criteria diluted the mission of the NSF:

“My ‘read’ of the proposed criteria is in complete conflict with my understand[ing] of the NSF mission to support fundamental fields of science and engineering and as the place ‘where discoveries begin’.”

Sixty-six respondents had specific suggestions for categories that were missing from the list of national goals (Figure 6). The two most frequent suggestions of topics to include were Social Welfare and Human Health; and Environment and Energy. Advancing Science; International Collaboration; Multidisciplinarity and Cross-Discipline Partnerships; Training and Education; Software, Data and Other Tools; and Economic Sustainability were also identified as potential missing national goals.

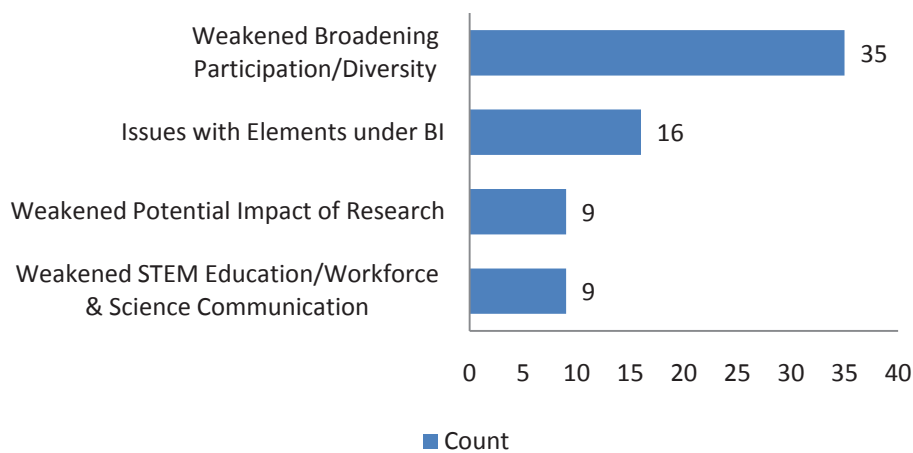
Figure 6. Suggested Additions to the Listing of National Goals (Codes are not mutually exclusive; data represent 66 unique respondents)



Attitudes toward Broader Impacts criterion

Sixty-five respondents commented on the revised Broader Impacts criterion; 53 comments indicated that the draft revision was weaker than previous drafts and 16 comments raised issues related to the elements under the Broader Impacts criterion (Figure 7).

Figure 7. Attitudes toward Revised Broader Impacts Criterion (Codes are not mutually exclusive; data represent 65 unique respondents)



- Thirty-five respondents reported that the draft revision detracted from a previous strength in the merit review criteria which sought to increase diversity and broaden participation.

- An example of a response on the weakening of broadening participation or diversity:

“The new language does not give appropriate weight to the national goal of increasing participation of women, persons with disabilities, and underrepresented minorities. The previous broader impacts language made it clear that ‘integrating diversity into NSF programs, projects, and activities’ was a specific area that ‘NSF staff will give careful consideration’...The loss of such language will cause the unintended effect of significantly diminishing the weight that reviewers will give to this critically important national goal.”

- Nine additional respondents reported that in their view, the draft revision limited the potential impact of NSF-funded research, while 9 respondents reported feeling that the draft revision hindered PIs’ ability to focus on the development of STEM education and the STEM workforce.

- An example of a response on the limiting of the potential impact of the research:

“The itemized list of questions concerning ‘Broader Impacts’ asks about impact on ‘national goals’ (which would apparently include economic competitiveness or national security). However it does not ask about impact

on other areas of science -- a type of "broader impact" that is in fact very important, and very valuable."

- An example of a respondent commenting on the weakening of STEM education and workforce:

"1. Broader impacts does not explicitly identify educational outreach as one of the possible ways for projects to have a broader impact. It is important to continue to provide incentive for scientists and faculty to engage elementary and secondary students, K-12 teachers, if it is appropriate to do so within the scope of the scientific proposal. a statement to this effect is critical."

- Sixteen responses raised issues with the content of the elements under the Broader Impact criterion.

- An example of a response commenting on the broader impact elements:

"For example, especially points 2-5 under Broader Impacts are redundant and actually don't make sense as Broader Impacts. What does the availability of adequate resources have to do with Broader Impacts?!"

Attitudes toward Intellectual Merit criterion

Twenty-six respondents discussed the Intellectual Merit criterion. Eighteen respondents indicated they were satisfied with the Intellectual Merit criterion as written, and 8 respondents raised issues with the Intellectual Merit criterion.

- An example of a response noting a degree of dissatisfaction with the Intellectual Merit criterion:

"I also think that more clarity on what constitutes intellectual merit would be helpful, beyond addressing five goals listed. In particular for education projects, sometimes the best projects contain a number of "tried and true" methods. I would hate to see these trashed because they are not "creative, original [sic] or transformative."

- An example of a response indicating satisfaction with the Intellectual Merit criterion:

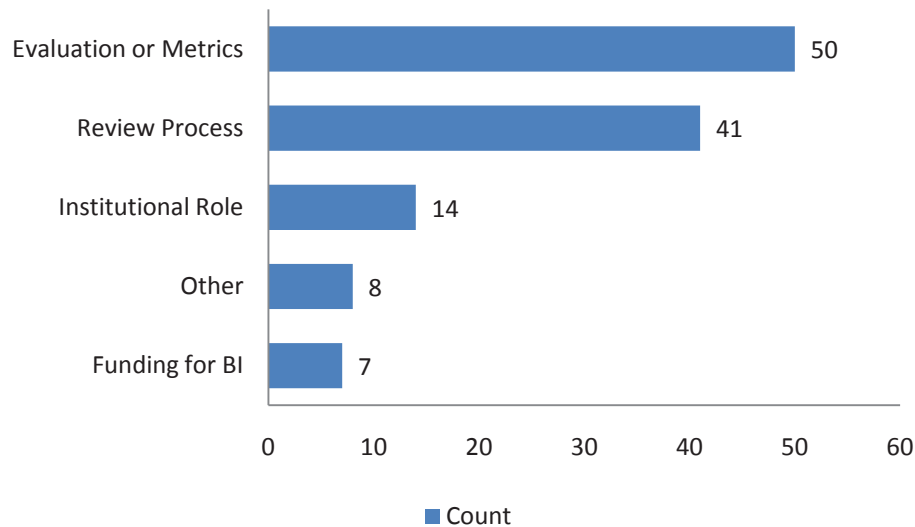
"The Intellectual Merit criterion is similar to the previous criterion, which is acceptable."

Comments on Implementation

Although people were asked to comment on the criteria, many respondents also provided suggestions regarding the implementation of the merit review criteria. More than one-third of respondents (102) raised issues related to implementation. These were

further broken down into Evaluation or Metrics, the Review Process, the Institutional Role, Funding for Broader Impact activities, and Other (Figure 8).

Figure 8. Implementation of Merit Review Criteria (Codes are not mutually exclusive, data represent 102 unique respondents)



- The 50 respondents who commented on evaluation or metrics were concerned with how broader impact activities would be evaluated during the review of a proposal, what the weighting of the two criteria would be, and whether there would be accountability after the fact. Others took issue with the use of the word “Collectively” in Principle #2, and with the assessment required by Principle #4. There were also a few respondents who were positive about the new evaluation methods.

- An example of a response commenting on evaluation of criteria:

“It is not clear to me how a merit review panel could decide how one PI's goals and aspirations for broader impacts are more likely to succeed than another's. There are no established methods for achieving these goals and aspirations, so it is hard to evaluate the likelihood of success. This uncertainty contrasts sharply with the clarity with which intellectual merit can be evaluated...As a PI, I feel much more confident about my ability to communicate the intellectual merit of the research I am proposing than the broader impact. The new principles are clearer and offer more guidance, but I am concerned that they will still be difficult to address effectively. I can demonstrate with preliminary results and logic that my proposed research is likely to succeed; I can only promise that my research will have the broader impact NSF is looking for.”

- An example of a response commenting on “Collectively”:

“Collectively, NSF projects ...’ This statement, does not make it clear that each project should satisfy the BI criteria, but that many projects taken together collectively have broader impacts. My concern is that a program manager could fund a couple of workshops for which they can provide no evidence for their impact, along with research projects with little BI work, but then make the point that the project collectively has BI activities.”

- An example of a response commenting on the assessment from Principle #4:

“The sentence in the preamble ‘Ongoing application of these criteria should be subject to appropriate assessment developed using reasonable metrics over a period of time.’ is confusing to me. By whom is the application of these criteria? Who will perform the assessment?”

- An example of a positive response related to evaluation:

“We appreciate the level of accountability implied in the new statement that is not found in the current version of the review criteria statement. The proposed review elements offer exceptionally clear guidance and metrics which potential reviewers and investigations should find helpful.”

- The 41 responses coded as Review Process discussed aspects other than evaluation of criteria, including qualifications of reviewers, necessary guidance for reviewers and grant proposal writers, ability of scientific reviewers to judge non-scientific BI activities, burden of addressing additional criteria and using space previously devoted to scientific merit, and other general suggestions for changes to the review process.

- An example of comment on the review process:

“But if the researcher is in an institution where doing the proposed research project HAS a broadening impact in and of itself, e.g., involving undergraduates into research at an undergraduate college, his/her answers could have a lot of redundancy, or s/he might not be able to use the space as efficiently as the case of the company example above. Perhaps the newer criteria for BI are trying to be more explicit, but the older ones had more flexibility in describing the unique situation each PI is in so that they can emphasize different strengths.”

- The 14 respondents discussing institutional role questioned the proper role of the institution for broader impacts activities and were concerned with smaller institutions being marginalized, among other uncertainties.

- Two examples of responses coded with reference to various aspects of the institutional role are:

“Third, it is unclear the meaning of department-level or institutional engagement, how it will be assessed, and whether and how it can be distinguished from cost sharing.”

“The Primary Undergraduate Institutions (PUIs) and the Masters Intensive Institutions seldom meet all of the intellectual merit levels of research 1 institutions, but our broader impacts strengthen our proposals.”

- The 7 responses on funding for BI suggested providing funding for broader impact activities.
 - An example of a response discussing funding for BI is:

“I'm concerned that Broader Impacts activities are not directly supported by NSF grants. As a soon-to-be postdoctoral scholar, and hopefully future Principal Investigator, I see many around me complain that Broader Impacts are an unfunded mandate that competes with research time. One solution would be to allow funding for Broader Impacts activities to be written into grants. This would make them a valid and valued part of normal research practice in the U.S. More broadly, funding Broader Impacts will show that NSF truly values these goals and will have the broader benefit of increasing the effectiveness with which NSF projects meet the National Goals.”

Conclusion

Responses were generally mixed, neither overwhelmingly positive nor negative. Over two-thirds of the respondents were from universities, and the majority of those were individual professors. Respondents commented on the national goals, revised broader impacts and intellectual merit criteria, and implementation. Most of those who commented on national goals felt that the list was missing key elements. The majority of responses related to the revised Broader Impacts criterion reported they felt the current version had a weaker emphasis on increasing diversity and broadening participation. The small number of responses related to intellectual merit was on the whole positive. A number of respondents discussed implementation, and most of these dealt with issues related to evaluation or metrics and the review process. Responses also included a number of specific suggestions for wording, format or organizational changes.

Appendix: Suggestions for wording, format and organizational change

Clarification Needed
Broader Impacts
"Broader impacts of the proposed activity" Since it is the collective sum of NSF projects that are supposed to have broader impact, I suggest changing the current text to "The purpose of this review criterion is to identify and assess the value of the broader impacts of the proposed project. Elements to consider are:"
"Broader impacts of the proposed activity" Element 5: I find element 5 confusing. Is it asking whether the PI has requested adequate resources? Or if there are adequate resources at the institution? Or both? I would suggest dropping or re-wording.
Which national goal (or goals) is (or are) addressed in this proposal? Has the PI presented a compelling description of how the project or the PI will advance that goal(s)? assumes that there are some specific national goals. I have the feeling that the support of basic research is not one of them. So I recommend a little editing to make it clear that the NSF promotes sufficiently justified basic research.
Element 2 calls for a —well-reasoned plan with —department-level or institutional engagement, innovations, team qualifications, and adequate resources. There is ambiguity in this requirement for those grants that primarily are educational outreach, dissemination, or diffusion of innovation efforts. This appears to be a —research-centric view that does not consider the full taxonomy of NSF grants.
Have any innovations been incorporated? This question leaves innovation undefined. Providing a new widget to an existing mechanical device may be innovative to the researcher or even the discipline, but how does that innovation broaden impact? How does the innovation support broader participation? How will the innovation serve society? This revised question is not applicable for these review criteria.
In both Merit item #5 and Broader item #5: Expand the concept of resources to go beyond financial to include things like facilities.
In the text for broader impacts, it is not clear in several places to what the word "activities" refers: the research itself or the broader impacts/outreach efforts. I believe that the text should be more explicit: can "activities" refer to the research, the focused "broader impacts" efforts such as outreach, or the synergistic output of the entire funded project?
Is the rationale for choosing the approach well-justified? By whom and for whom? By itself this criterion has no relevance to increasing the impact of the work in the broader society.
Subpoint 2 would seem to imply something about cost-sharing, and I don't think we want to do that. For specific programs that might require department/institutional engagement, we can have an additional review criterion.
We are also concerned that the document should more clearly specify what is intended by the statement that "Broader impacts may be achieved through the research itself..." In particular, the language should state that proposers are required to be specific in identifying how the research itself meets broader impact criteria and at what stage in the research plan those broader impact goals are expected to be met.
Intellectual Merit and Broader Impacts
Even before, distinguishing what belongs under Intellectual Merit versus Broader Impacts was not always clear... At the very least, I strongly urge NSF to clearly differentiate one criterion from the other. It should be completely clear to proposers and reviewers what meets each criterion.
Explain the relationship between the Intellectual Merit and Broader Impacts criteria.
In both Merit item #2 and Broader item #2: A better description of what is intended by "engagement" should be included.
Intellectual Merit

A rewording for Merit item #2: To what extent does the proposed activity explore creative and potentially transformative concepts rather than incremental advances?
Element 5, under “Intellectual merit of the proposed activity”. What does “Is there sufficient access to resources?” mean? As a former AD, current NSF grantee and NSF reviewer, I can't make heads or tails of it. I would suggest deleting it. (Trust me, fewer elements will produce better reviews.)
I do have one concern: under “intellectual merit” the term “transformative” appears as in the past. This seems to be an invitation to hyperbole and exaggeration which can needlessly add to the challenge of providing an informed and reasoned review. Can this phrase be removed? If not, can you provide some examples of what might practically be considered “transformative”?
In number 3 under intellectual merit. It would be better to say "with a ready to go effective work plan" or something else in plain english. The phrase "well conceived and organized" could simply refer to the proposal and not necessarily how the PI is going to do the work. I
Please explain the definition of Intellectual Merit and its application for grants that are primarily aimed at dissemination of findings (through public media or through educational content), facilitating the diffusion of innovation, building capacity (e.g., centers and digital libraries), and broadening participation (intentionally concentrated on the recruitment and retention of members of under-represented groups).

Implementation
Broader Impacts
In addition, review panelists need very clear guidelines on assessing whether the broader impact criterion has been met by a given proposal and its results can be achieved in the proposed time frame.
Perhaps NSF might consider how to allow – or even encourage – the greater aggregation of broader impacts beyond individual grants – so that institutions might show the impact by unit or even across an entire campus
Provide more guidance for both PIs and reviewers how to ensure that grants of all kinds satisfy the Broader Impacts criterion for each NSF grant made.
Intellectual Merit and Broader Impacts
I'd like to suggest that more weight in the Overall Score be given to Intellectual Merit than to Broader Impacts---say 75%/25% or 67%/33% rather than 50%/50%.
N/A
[Merit Review Wording Change] Reviewers of all NSF proposals are asked to evaluate proposal quality on the basis of two merit review criteria: intellectual merit and broader impacts. Separate evaluations relevant to each criterion are requested. For each criterion, five questions are provided to guide the reviewer's evaluation. (I would suggest a single response field in FastLane for each criterion, not for each question. The questions could be provided at the top of the response field or, better, in an adjacent field for easy reference.)
Proposing institutions should be encouraged to put effective institutional programs into place (e.g., for K-12 outreach) into which individual investigators can tie. This will increase cost-effectiveness. However, "signoff" or "certification" of such an arrangement must involve the person or organization responsible for this institutional program, rather than some bureaucrat at the top of the institution. If an investigator is proposing to tie into *my* existing outreach program, then *I* must certify the arrangement.
Require that NSF's mandate to diversify the S&E workforce be addressed in every proposal.

Insert Question
Broader Impacts
Which national goal (or goals) is (or are) addressed in this proposal? Has the PI presented a compelling description of how the project or the PI will advance that goal(s)? IS THE PI CLEAR ON HOW TO PRESENT THESE GOALS AND FINDINGS TO THE GENERAL PUBLIC

Is the rationale for choosing the approach well-justified? Have any innovations been incorporated? HAS THE PI GROUNDED THE PRESENTATION IN PUBLISHED, ESTABLISHED THEORY
How well qualified is the individual, team, or institution to carry out the proposed broader impacts activities? DOES THE PI, ESPECIALLY A YOUNG PI, HAVE A SUPPORT NETWORK TO BE SUCCESSFUL
Are there adequate resources available to the PI or institution to carry out the proposed activities? SEE NUMBER 3 [HAS THE PI GROUNDED THE PRESENTATION IN PUBLISHED, ESTABLISHED THEORY]
“How well does the proposed activity address national goals for a robust STEM workforce by broadening the participation of underrepresented groups (e.g., gender, ethnicity, disability, geographic, etc.)?”
Change Question # 3 under Broader Impacts to “Is the rationale for choosing the approach well-justified? Have any innovations been incorporated? Is the strategy for monitoring progress appropriate?”
Is the rationale for choosing the approach well-justified? Have any innovations been incorporated? I am pleased to see explicit inclusion of innovation here. However the use is very confusing. 2nd part of the question #3 could be split to: Will the proposed activity lead to innovation? and Are innovative approaches incorporated into the proposed activity?
A question I would add to the Broader Impact criteria, for example, would be “How well are the broader impact activities integrated with the research plan?”
A well-reasoned plan for broader impacts activities should include ensuring that outreach and broadening participation activities result in positive, systemic improvements and enduring impact. This could include a range of meaningful partnerships with entities that have ongoing access to desired audiences.
Along these lines, to help a reviewer assess Broader Impacts, perhaps it would help if a proposer would be required to classify their Broader Impacts into e.g. short-term vs. long-term, basic versus applied, concrete versus broadly influential.
How well does the activity advance discovery and understanding while promoting teaching, training, and learning?
How well does the proposed activity broaden the participation of underrepresented groups (e.g., gender, ethnicity, disability, geography, etc.)?
If broadening participation at multiple levels is a priority, I recommend that more specific language to that effect is incorporated in the Broader Impacts criterion.
To what extent will it enhance the infrastructure for research and education, such as facilities, instrumentation, networks, and partnerships?
What may be the benefits of the proposed activity to society ?
Will the results be disseminated broadly to enhance scientific and technological understanding ?
Intellectual Merit
"What role does the proposed activity play in advancing knowledge and understanding within its own field or across different fields? "Integrating words to the effect of "does the proposed activity use expertise from these different fields as needed" would encourage researchers to expand the possible advances across fields.
How well conceived and organized is the proposed activity? SEE ITEM BELOW _ DOES THIS PROPOSAL RELY ON PUBLISHED, ESTABLISHED THEORETICAL FOUNDATIONS?
How well qualified is the individual or team to conduct the proposed research? IS THERE A MECHANISM IN PLACE TO ASSIST THE YOUNG PI TO BE SUCCESSFUL
How well conceived and organized is the proposed activity? (If appropriate, the reviewer will comment on the quality of prior work.)
N/A
Does the proposal ask a fundamentally interesting and scientifically important question, one for which the answer will be a significant advancement of knowledge with potentially broad impacts? Are the proposed means for addressing the question feasible so that the answer is potentially attainable? Is the method and design well-

conceived so that the answer will be as unambiguous and definitive as possible? Are the logistics (including cost efficiency), practicability (including local infrastructural support), and feasibility (including investigator qualifications) sufficient to enhance the likelihood of success? I suspect that in one fashion or another, most scientific reviewers address these same issues, but they are only hinted at in the current version and should be emphasized and explicit.

Loosening Criteria

Broader Impacts

First, it should be made clear that a proposal that addresses one, and only one, of the "important national goals" is sufficiently qualified for funding. As worded, nowhere is it clarified how many different "important national goals" should be addressed. Thus, proposals that address many of them (likely if not unavoidably in a superficial manner) will obtain higher rankings, even if the intellectual merit of the proposed research does not warrant such ranking.

Focus should be allowed, and even encouraged. An investigator should be encouraged to do a superb job of addressing one dimension of "Broader Impact," versus a mediocre job of addressing multiple dimensions. Excellence and impact should be the goal. Obviously, there must be a broad portfolio of "Broader Impacts," but the burden for this breadth should not fall to each individual investigator -- to do this would pretty much guarantee mediocrity. The specification should be clear in this regard.

Innovation or novelty should not be required. If there is an existing approach to achieving "Broader Impacts" that works, all the better. The goal here is indeed "impact," not "innovation" or "novelty." "Innovation" or "novelty" are fine, but they should not be required.

Insert the following sentence after the first sentence describing Broader impacts of the proposed activity: "National goals include but are not limited to those identified above."

Repeated references to "national goals" throughout the proposed criteria may be appropriate for other federal research-funding agencies that underwrite mission-driven research projects, but appear to be changing the NSF attention away from its proven strength in basic science. We suggest they be deleted or rewarded to affirm and emphasize that the collective NSF research portfolio should have a broad impact, but that each individual activity proposed need not have the same role in that broader impact.

The opening section should begin with a strong statement about the NSF's core mission of supporting and promoting scientific research, including basic research if such is the intent, to the effect that pursuit of such research in itself is an important and in this context paramount national goal, and one that provides the motivation for the "intellectual merit" criterion and the hope for serving "broader impact" criteria without the express requirement that these be addressed in the narrow form stated.

We do not believe that broader impacts activities need to be innovative. While innovation is very important in the Intellectual Merit scope of the grant, we believe that broader impacts efforts should follow proven or promising practices for reaching and benefiting society.

We suggest a simple change to the proposed criterion that will avoid limiting researcher creativity and autonomy: restore some vagueness to the wording, or at least an escape clause, that will allow researchers to propose broader impacts not included on the proposed list. This could be accomplished by restoring something like the 'benefits to society' clause of the current criterion or by adding explicit language to suggest that the proposed list is not exhaustive, but merely representative.

Intellectual Merit and Broader Impacts

I do worry, however, that the way these criteria are written suggests that PIs should meet as many of these broader impact criteria as possible. That should not be the objective. The objective should be to have a well thought out broader impacts plan that makes a valuable contribution to one of the national goals through the PIs proposed research.

New Criteria
Broader Impacts
Has the PI identified institutional partners they could work with to assure that their activities have the greatest chance of success and the greatest potential for wide exposure and impact?
Is there a plan for the institutionalization of the activities related to broader impacts to continue after the grant has ended?
Regarding "broader impact," proposers should be invited to say how their work will impact science and engineering research outside of their immediate discipline - in other words to talk about the "broader scientific impact" of their proposed work. This vital criterion is missing altogether in the current draft.
The Board may also want to consider moving into IM aspects of broader impacts criteria that will allow selection of important work.
We recommend that a new element follow element 1 under the Broader Impacts criterion. It could be worded as follows: "To what extent has the PI demonstrated how the proposed project will broaden participation in STEM?"
Intellectual Merit and Broader Impacts
In addition, we believe in the importance of disseminating findings and lessons learned in addition to the research itself; we encourage NSF to take this into consideration as these drafts are finalized.
we recommend that the NSF require every submitted proposal to address its contribution to the diversification of the S&E workforce (e.g., designated subsection within each proposal submitted).
Intellectual Merit
How will the progression forward manifest (presentation, publication and data management; creation of intellectual property; technology transfer; diffusion and/or other)?
N/A
<p>Additionally, NSF might consider adding a separate section on more procedural criteria such as:</p> <ul style="list-style-type: none"> • What is the research and evaluation based justification that this approach will be better than existing related approaches? It is often useful to suggest that the proposer be asked to state their claims of what they intend to accomplish and why and then to provide evidence of why it is likely they will succeed and how they will measure this success. • How will the work of this applicant be evaluated to learn if it is more effective than the related alternatives and thus worth disseminating? • How does the work impact diverse populations or users? For example, is it just as effective with poor Hispanic girls as it is with affluent Asian American boys? • How will the results be disseminated to have the greatest positive impact? • What are the indicators that the proposer will be able to implement the activities as planned such as staff qualifications, resources, management and evaluation plans?
This suggested change will significantly weaken NSF's efforts to improve diversity in STEM fields, as applicants will no longer be required to consider and directly address in their proposals the importance of improving the participation and advancement of underrepresented groups in STEM fields of study and STEM careers.

Other
Broader Impacts
"Broader impacts of the proposed activity" Element 1: I suggest re-wording to eliminate national goal. "What

are the broader impacts of the work proposed? Has the PI presented a compelling and credible description of that broader impact?"
ASTC encourages NSF to ensure that any revision of the Broader Impacts criterion does not become a "checklist" rather than a means to actively advance Broader Impacts and the public understanding of the nation's investment in research.
I am a bit worried that the list as presented seems restrictive rather than exemplary; what if I identify a broader impact for one of my research projects that does not fit neatly into the "national goals" listed? It would help to have an "other – please specify" option.
I would prefer having only the intellectual merit section, followed by a P.I. prompt that in effect says" Are there any other factors that you wish to mention with regards to this proposal?"
Regarding "Broader Impact", I believe it is appropriate just to ask about "Broader Scientific Impact".
Under Broader Impact #3. Please delete "Have any innovations been incorporated?"
Intellectual Merit and Broader Impacts
The NSF might require attentiveness to two categories of "broader impacts," one of which has to do with expanding STEM activity (goals 2, 3, 5, 6 in the list) and the other with economic, security, and infrastructure impacts (1, 4, 7, 8, 9).
The current headings, Intellectual Merit and Broader Impacts suggests that all of the intellectual contribution is in the STEM research. Perhaps you should change these to: Intellectual Merit of the STEM Research; and Intellectual Merit of STEM Societal Engagement
Intellectual Merit
Header: substitute "state-of-the art" for "frontiers"
I suggest removing the phrase "within its own field or across different fields" from the "Intellectual merit" section.
N/A
In conclusion, I strongly urge that any statement of principles that accompanies the merit review criteria should * consist of a small number of principles, each clearly and unambiguously stated; * be clearly separate from the review criteria themselves; * be formulated in such a way that the specific merit review criteria are traceable to those principles; and, * the principles themselves each be clearly traceable to the merit review criteria.

Wording Change
Broader Impacts
"Are there adequate resources available to the PI or institution to carry out the proposed BROADER IMPACT activities?" --AC-GEO comments: we suggest adding "broader impacts" here for clarity
"How well qualified is the individual, team or institution to carry out the propose4d broader impacts activities?" --AC-GEO comments: Consider replacing "qualified" with "prepared" or "ready". One objective of the broader impacts criterion is to encourage scientists to participate in activities they may not be formally qualified for.
"Is there a well-reasoned plan for the proposed BROADER IMPACT activities, including, if appropriate, department-level or institutional engagement?" --AC-GEO comments: we suggest adding "broader impacts" here for clarity
Is the rationale for choosing the approach well-justified? Have any innovations been incorporated? Is there a well justified assessment plan?
Are there adequate resources available to the PI or institution to carry out the proposed activities related to broader impacts?
How well qualified is the individual, team, institution, or partnered educational groups to carry out the proposed broader impacts activities?
Are there adequate resources available to the PI or institution to carry out the proposed activities, either in

the PI's institution or through external educational/communication institutions?"
Use "principal investigator" rather than "PI" here and elsewhere.
I would change "carry out" to "accomplish" in the text.
Is the rationale for choosing the approach well-justified? Have any innovations been incorporated? Is assessment or evaluation involved? If appropriate, has department-level or institutional engagement been included?
Is there a well-reasoned plan for the proposed activities and a compelling description of how the project or the PI will advance that goal(s)?
What should be sought is "A well justified reason for choosing...".
Re-write point 1 of Broader impacts of the proposed activity to read: "Does the proposal explicitly identify and address one or more national goals? Has the PI presented a compelling description of how the project or the investigators will advance that goal(s)?"
Intellectual Merit and Broader Impacts
On a minor editorial note, the elements of both the IM and BI review criteria include resource sufficiency. The elements would read better if the wording were more similar. I prefer the wording of BI element 5, and would propose something like "Does the project team have access to sufficient resources to carry out the proposed activities?"
The only addition I might make is that questions on "adequate resources" for both the Intellectual and Broader Impacts Review Criteria should explicitly include infrastructure, i.e., "adequate resources and infrastructure." The word resources rapidly devolves into money in many people's mind.
Intellectual Merit
What role does the proposed activity play in advancing knowledge and/or practice within its own field or across different fields?
Change Question #3 under Intellectual Merit to "How well conceived and organized are the proposed activities and progress monitoring strategies?"
It seems for symmetry (and sensibility) one could edit 1 to be: 1: What role and impact does the proposed activity play in advancing knowledge and understanding within its own field or across different fields?
Item 4: Instead of "How well qualified...", read "The qualifications of the individual(s) and/or team..."
Regroup
Intellectual Merit and Broader Impacts
Are there adequate resources available to the PI or institution to carry out the proposed activities? Again, this seems to be a repeat of Intellectual Merit Review Criterion: Is there sufficient access to resources? NAPE believes that this question will require proposer to address their own institutional support and resources and will fail to require the proposer to consider the broader impacts of her or his work to society and the community or the engagement of underrepresented populations and the institutions that serve them.
How well qualified is the individual, team, or institution to carry out the proposed broader impacts activities? If the research must align to a National Goal and the broader impacts must align with the National Goal, this question requires only a restatement of the Intellectual Merit Review Criterion: How well qualified is the individual or team to conduct the proposed research? This question does not make clear what the broader impact activities are beyond the National Goals. The National Goals are NOT synonymous with broader impacts, so this question is unclear. NAPE does not believe this question will elicit information that will broaden the participation of underrepresented groups or ensure the broader impact of the program per se.
I suggest for your consideration that you group the goals into two sets (shown below), and give some privilege to activities in the first set (be that "added attractiveness", "higher priority" or at the extreme "one from column A"). Those in Set 2 can be covered by less critical, less innovative, more "business as usual" sorts of activities in my opinion. It seems to me that the STEM human capital issue is the paramount one facing our nation as our competitors move much more aggressively to educate larger fractions of their populations in STEM fields.

<p>This is where the economic action will increasingly lie for developed nations.</p> <p>Set 1</p> <p>Development of a globally competitive STEM workforce. Increased participation of women, persons with disabilities, and underrepresented minorities in STEM. Improved pre-K–12 STEM education and teacher development. Improved undergraduate STEM education.</p> <p>Set 2</p> <p>Increased economic competitiveness of the United States. Increased partnerships between academia and industry. Increased public scientific literacy and public engagement with science and technology. Increased national security. Enhanced infrastructure for research and education, including facilities, instrumentation, networks and partnerships.</p>
<p>I think it would greatly reduce the confusion in the PI community to merge the “Elements to consider...” sections into a single set of criteria as much as possible. Note that many of the bullets under the IM and BI components are more or less the same. Here is one suggestion.</p> <p>Intellectual merit of the proposed activity</p> <p>The goal of this review criterion is to assess the degree to which the proposed activities will advance the frontiers of knowledge</p> <p>Broader impacts of the proposed activity The purpose of this review criterion is to ensure the consideration of how the proposed project advances a national goal(s).</p> <p>The elements to consider when evaluating each of these are:</p> <p>1. What role does the proposed activity play in advancing knowledge and understanding within its own field or across different fields? 2. To what extent does the proposed activities suggest and explore creative, original, or potentially transformative concepts? 3. Is there an organized and well-reasoned plan for the proposed activities, including, where appropriate, department-level or institutional engagement? 4. How well qualified is the individual or team to conduct the proposed research and broader impacts activities? 5. Are there adequate resources available to the PI or institution to carry out the proposed activities?</p>
<p>My view would be to provide definitions of both what we mean by Intellectual Merit and Broader Impacts and then ask PIs, reviewers, and POs to address a common set of questions about both</p>
<p>Please eliminate the Broad Impact category and replaceit [sic.] as well as the Intellectual Merity [sic.]category with a single category such as Transformational Impact on Existing Paradigms.</p>
<p>Move Criterion</p>
<p>Intellectual Merit and Broader Impacts</p>
<p>I feel that one must think very carefully about what forms of "breadth" constitute "Broader Impacts" and which constitute "Intellectual Merit." For example, I have heard arguments that "impacting disciplines beyond one's own" should be considered "Broader Impact." I don't buy it. I think this falls under "Intellectual Merit." I'll be honest: I have some concerns, too, regarding "National Security" and "Economic Competitiveness."</p>
<p>Items that I would recommend to exclude from BI and moved to criteria for the research effort: ii. Increase national security -->move to the intellectual merit section</p>
<p>Items that I would recommend to exclude from BI and moved to criteria for the research effort: Increased economic competitiveness of the US --> move this to the intellectual merit section</p>
<p>While this question is important, we suggest it be placed under Intellectual Merit since it does not consistently support increasing the broader impact of the research or project.</p>

<p>Duplicate</p>
<p>Intellectual Merit and Broader Impacts</p>
<p>The points under Intellectual Merit and Broader Impacts are very redundant.</p>
<p>I am OK with the logic and the nine sub-goals. And the first subpoint. • subpoints 2-5 seem to be duplicative with the Intellectual Merit. I don't think we should ask the same question twice – and I think these belong under Intellectual Merit.</p>

However, under "Broader Impacts", points 2., 3., 4. and 5. are (or appear to be) redundant with points under "Intellectual Merit". With the expansive list of National Goals, only point 1. under Broader Impacts is really needed.

I can't figure out the difference between "2" under Intellectual Merit and both "2" and "3" under broader impacts. They both seem to be asking the exact same question using slightly different words.

I see duplicate questions between Intellectual Merit (IM) and Broader Impact (BI) about PI's qualification (IM#4 & BI#4) and sufficient resources (IM#5 & BI#5).

Items 4 and 5 listed under IM and BI, are essentially the same, which will lead to confusion and repetition in submitted proposals. Those two items should be pulled out, and placed in either a separate category (because they really don't fit well in IM or BI), or should be asked as a sort of 'umbrella' question regarding the whole of the proposal.

Appendix I

***Making Judgments about Grant Proposals:
A Brief History of the Merit Review Criteria
at the National Science Foundation***

MAKING JUDGMENTS ABOUT GRANT PROPOSALS: A BRIEF HISTORY OF THE MERIT REVIEW CRITERIA AT THE NATIONAL SCIENCE FOUNDATION

Marc Rothenberg

National Science Foundation, Arlington, VA, USA

This is a brief study of the changes in the merit review criteria for proposals submitted to the National Science Foundation (NSF) over its 60-year history. Because far more worthy proposals are received than are fundable, it has been necessary for the NSF to develop review criteria to distinguish among meritorious proposals. For reasons of politics and policy, NSF has had to consider criteria other than simply good science—what are now known as “broader impacts.” This study shows that the general nature of the criteria has not changed over the years. Instead, the NSF has fought a continuing battle to clarify the criteria and persuade the peer communities to use the criteria as set down. The trend from the 1960s has been to reduce the number of criteria, but to broaden the definition of those that remain.

Key words: National Science Foundation; Merit review criteria; Peer review

In December 1951, the then 1-year-old National Science Foundation (NSF) issued its first call for grant proposals. The decision of the senior staff to meet its mandate through grants rather than contracts was contrary to the usual practice of most federal science agencies. Rather, it followed the model established by private American foundations that supported scientific research. The mission of the NSF was to support basic research across the entire spectrum of science and engineering disciplines, as well as fund science and engineering education. In the opinion of the NSF staff, a contract was not the appropriate vehicle for providing funds to support basic research. Contracts called for the delivery of an agreed upon product to the contracting agency, but the basic research that the NSF would fund was to be made available to the entire world, not limited to the use of the NSF. Moreover, implicit, if not explicit, in the issuing of a contract was a reasonable assuredness of delivery. There was great uncertainty, however, what the final “product” might be in basic research (6).

In yet another early far-reaching decision, the

NSF elected to utilize external peer review as one, but only one, tool in its decision-making process. The NSF staff and the scientific community were engaged in what Director Alan Waterman described in the 1952 annual report (15) as a “collaboration” (p. vi). Although the NSF solicited advice from the research community concerning the funding of specific proposals through advisory panels—sometimes in the early history of the NSF called “panels of scientific consultants”—and mail reviews—with each NSF program given the freedom to decide what was the proper and appropriate balance between the two methods of review—the recommendations for funding came not from the panels but from the NSF program officer, with ultimate decision making reserved for the National Science Board (NSB), the governing board of the NSF (15, p. 14).

The history of proposal review at the NSF is a large topic. It encompasses issues like the evolution of the mechanisms of review, the transparency of the process, the perception of fairness, and the extent of Congressional oversight, to name but a

few topics. Although George Mazuzan has written a study of the review system through the mid-1980s (8) that looks at many of these topics, he did not consider the history of review criteria. More generally, considerations of review criteria are missing from historical studies of the NSF (although not from the literature of the sociology of science). This study is a preliminary overview in an attempt to begin to fill a gap. The focus will be on issues of general policy regarding review criteria from the perspective of the NSB and NSF senior management.

It was understood by the NSF from the beginning that if the review system was to be fair, clear criteria for evaluating proposals had to be established. These criteria would have to serve two purposes. The first was to eliminate poor proposals from consideration—to ensure that good rather than mediocre research was being supported. The additional and more difficult consideration was selecting from among the good proposals when the NSF's budget allowed it to fund only a fraction of the proposals it deemed worthy of support. This issue arose early in the NSF's history. In fiscal year (FY) 1952, the first year the NSF issued grants, Director Waterman estimated that at least 40% of the proposals submitted were fundable (6, p. 174). But, of the \$13 million requested by applicants that year, only \$1.1 million (8%) could be handed out (15, p. 13). During the subsequent rapid increase of NSF funding through FY 1968, the percentage of proposals funded steadily climbed, peaking and holding at approximately 61% in the late 1960s (17, p. 10). Since 1980, the rate has never exceeded 40% (9,20,25).

So what criteria were the external peer reviewers asked to consider? How were they to decide among the proposals? The initial criterion (announced to the research community in the December 1951 call for proposals) (15) was "the scientific merit of the proposed research, including the competence of the investigator" (p. 51). However, in practice, additional considerations were necessary for a final judgment (15). The external reviewers were asked to evaluate the proposal using four related criteria. In addition to scientific merit, they were to consider duplication of effort—how unique was the proposed research; reasonableness of budget—no proposal was turned down exclusively for reasons

of budget, but negotiating budgets downward became commonplace; and the quality of available personnel and facilities at the host institution. The NSF program officers were asked to evaluate the proposed research's relation to the national effort, as well as issues of geographic and institutional distribution. Technical competence was a necessary—and the most important—element in proposal evaluation, but it was not sufficient. And this remained true throughout NSF history. Over the next six decades, the NSB modified the NSF review criteria language: refining, clarifying, and responding to changes in the make-up of the NSF portfolio of programs. But one aspect of the criteria remained constant. Nontechnical issues were an important element in the NSF's official criteria. In current NSF language, proposals also had to address the issue of "broader impacts."

After the first flurry of decisions in the early 1950s, the next major statement regarding selection criteria occurred in 1967, at the end of a decade and a half of sustained growth and major changes in the scope and volume of NSF activities. Congress had enlarged the NSF budget from FY 1952 to 1967 from \$3.5 million in FY 1952 to almost \$480 million by FY 1967 (6,16). Although the number of research grants approved by the NSF increased from 96 in FY 1952 to 3,976 in FY 1967, there were also important qualitative differences in the way the NSF was distributing its funds, especially beginning in the late 1950s. In FY 1956, for example, over half the NSF funding went for grants to support basic research. Only approximately 3% went for the support of research facilities. The distribution of funds was quite different in FY 1967. Only 36% of the funding went to basic research projects. Research facilities, including the national research centers like Kitt Peak National Observatory and the National Center for Atmospheric Research, which first became significant recipients of NSF funds in FY 1956, absorbed 8% of the FY 1967 spending. The institutional grants programs, which provided funds for construction and for discretionary spending by academic institutions, and were first awarded in FY 1959 (5), represented another 17% of the NSF expenditures in FY 1967.

In addition, support for applied research was becoming an obvious issue. Although the Daddario amendment, which made support of applied re-

search explicitly part of the NSF charter, did not pass until 1968, Rep. Emilio Q. Daddario had introduced it in March 1966, and the NSF management was keenly aware of it, as demonstrated by a discussion of its provisions in the FY 1967 annual report (16, pp. 5–6).

The “Criteria for the Support of Research” approved by the NSB in May 1967 (16) were presented to the scientific community “as a clarification and reaffirmation” (p. 213) of NSF philosophy that had been in place from the very beginning, not as a radical new vision. The NSB concluded the discussion of these criteria by reiterating that they constituted “no major departure from current practice” (p. 219). One conclusion that could be drawn from such public declarations is that the concern about the potential broader impacts of a grant proposal, at least in the form of the education of graduate students and possible technological benefits, which appear among the 1967 criteria, predates its codification in 1967.

The NSB decided to divide the criteria by the type of institution receiving the funding. There were different criteria applied to academic research compared to research conducted in research institutes or national centers. For academic research, the NSB established five criteria. Three can be viewed as proving clarification for the criteria related to the scientific merit of the proposal. These included the “promise of scientific results,” “the potential scientific impact,” and “the degree of novelty, originality, or uniqueness.” But the other two looked beyond the laboratory to the rest of the academic institution and the wider world. One asked about “the educational value of the proposed research.” The last criterion was “the relevance of the proposed work to potential applications.” This criterion explicitly raised the possibility that among relatively equal proposals, a practical payoff might give a proposal an edge (pp. 217–218).

The issues facing reviewers of grants for research institutes and national centers were quite different than those evaluating research grants. Reviewers might be deciding whether to establish the institution in the first place, increase funding for an established center, terminate a program, or have it transferred to another facility. Two of the criteria dealt with technical merit. Did this institution “meet a real scientific need” and was it supported

by “first-class scientists.” Two were more relational: could the research be done by other organizations or institutions and what was the relationship of the research facility to the academic community? The final three worried about the impact of the research on the wider world, asking the reviewers to consider the training potential of the facility, the possibility of crossing disciplinary boundaries, and the possibility of “tangible social benefits” emerging (pp. 218–219).

Seven years later, the NSB revisited (12) the question of selection criteria. In the interim, applied research had become a major element in the NSF portfolio, while institutional grants program had fallen into disfavor with the Nixon administration. Not only had the Daddario amendment passed, but new programs had been developed to fund applied research proposals. In November 1968 Director Leland J. Haworth asked for a modest \$15 million for a new program called Interdisciplinary Research Relevant to Problems of Our Society (IRRPOS). IRRPOS only lasted 2 year before it was replaced by a larger, more elaborate program. In the winter of 1971, with the encouragement and support of President Richard Nixon’s administration, the NSF established a new program, Research Applied to National Needs (RANN), and a new home for its applied research activities, the Directorate for Research Applications. The NSF was now in the business of funding goal-oriented programs. In FY 1974, RANN represented approximately 12% of the NSF expenditures. In contrast, funding for institutional grants had fallen sharply and in that fiscal year constituted only 1.5% of the expenditures (1,18).

The NSB response to the increasing number of grants supporting applied research was to rethinking the selection criteria. The new criteria, 11 in number, grouped into four categories, were approved in October 1974. It was understood that for any given NSF program, some of the criteria would be more important than others. The NSB also emphasized that there was to be no effort to provide “precise quantification” or “unambiguous rank ordering” among the criteria (18, p. 131). The four broad categories were to the ability of the researcher and the adequacy of his/her institutional base; the quality of the science, with particular emphasis on the possibility of an impact upon other

disciplines; the utility or relevance of the research; and the long-term scientific potential, including impact upon younger colleagues and students, institutional structure, and diffusion of techniques. In all cases, the criteria set out in the first category would be applied.

For grants that focused on institutions rather than individuals, such as those that supported national research centers, there were two additional criteria: need and potential (18, p. 132). Wrapped into these two criteria were most of the criteria established in 1967 for institutional grants. What had disappeared were the questions of social benefits and other wider impacts. But those were covered by the fourth category of criteria for all grants.

Seven years later, circumstances had changed and the review criteria were revisited once again. In particular, the NSF had gone through a number of reorganizations as it attempted to find the proper home for applied research. The Directorate for Research Applications had given way to the Directorate for Applied Science and Research Applications in 1978, which in turn gave way to the Directorate for Engineering and Applied Science in 1979, which in turn gave way to the Directorate for Engineering in 1981. Engineering was now a full partner in the NSF, while applied activities were scattered among a number of directorates (1).

As a result of these changes, the language of the review criteria, although not the thrust, underwent some serious tweaking and consolidation. The changes were partly cosmetic. The number of criteria was reduced to four, but each criterion corresponded to one of the four previous categories: research competence, merit of the research, utility, and effect on infrastructure (21). One major change in language was the introduction of the word engineering in the criteria dealing with merit of research and infrastructure. Another major change was in the form of explanatory commentary, not an actual change to the criteria. In the discussion of criterion 4, the NSB specified what the phrase "effect of the research on the infrastructure of science and engineering" meant, making the concern of the NSF with broader impacts more explicit. Participation of underrepresented groups—minorities and women, the allocation of resources among institutions and geographical areas, and the stimulation of

underdeveloped fields were all to be considered part of this criterion (p. 13).

A new issue arose in the mid-1980s. The Federal budgets for FY 1983, 1984, and 1985 all contained direct Congressional authorization or appropriations for significant academic projects, ranging (3) from \$750,000 for a pediatric research center at the University of Connecticut to \$19,000,000 for the construction of an engineering research center at Boston University. Part of the context for this crisis, a decline in funding for scientific and engineering facilities in academia, will not be addressed here. What is important for this study was the perception by the NSF and the NSB that the introduction of directed appropriations (usually designated in the media as "pork-barrel funding") into federal funding of scientific and engineering facilities was threatening to undermine the peer review process, and according to the NSB Committee in Excellence in Science and Engineering (14), could ultimately "threaten the integrity of the U.S. scientific enterprise" (p. 1). The committee also acknowledged that the nature of academic science and engineering was changing, with increasing resources being directed towards large multidisciplinary and even multiinstitutional projects. In reaction to its committee's warnings, the NSB called upon the NSF to reaffirm the importance of the merit review system, while at the same time, reexamining and analyzing the review process.

NSF Director Erich Bloch responded to the NSB's call by establishing an external Advisory Committee on Merit Review. Chaired by Norman Hackerman, a former chair of the NSB, the 11-member committee spent over a year examining the issue, looking at peer review at other federal agencies as well as the NSF, before reporting back in September 1986 with a set of recommendations (19) which were, for the most part, accepted by the NSF. The committee affirmed that the review process at the NSF was "by and large functioning well" (p. 2), although it did call for what it perceived to be necessary modifications to improve the process and quality of the reviews.

The committee also recommended a major terminology change, one that went to the heart of the issue of review criteria. According to the committee, the term "peer review" was properly a restric-

tive term referring to the evaluation of the technical aspect of the proposal. However, for more and more federally funded research, "technical excellence" was, in the words of the committee, "a necessary but not fully sufficient criterion for research funding" (19, p. 2). Acknowledging that the NSF (as well as other federal agencies) was using a wide range of nontechnical criteria as part of the decision-making process, the committee suggested that the term "merit review" more accurately described the NSF selection process (19, p. 2). The recommendation was accepted by Bloch. As of December 1986 the NSF officially utilized "merit review" (2).

In doing so, the NSF had to reassure the research community that it was not discarding technical review. Director Erich Bloch reminded the staff (2) (and indirectly the larger community) that "the quality of the proposed research and the competence of the investigators" have always served as the "primary criteria for selection of research projects." This was an effort to reassure the research community, which was uneasy about the change (26). However, he also reminded them (2) that "once excellence has been established," other factors, such as "goals of equity and distribution of resources among institutions and geographic areas" had to be taken into account.

Another point raised by the committee was how important it was for the NSF to support innovative but possibly high-risk research (19, pp. 29–30). Implied in the report was that the NSF had to go beyond the peer review process if innovation was to be encouraged. Later NSF statements reinforce this point. There was a danger that peer review, with its emphasis on technical competence, could result in "incrementalism and conservatism" (7, p. 123).

A number of changes and circumstances led to the next reexamination of the review criteria, beginning in 1996. According to congressional testimony (4) by Mary E. Clutter, Assistant Director for the biological sciences at the NSF, the reexamination was due at least in part by the realization that the four criteria had been adopted at a time when the NSF had little involvement in education (it coincided with the Regan administration attack on NSF funding of education that resulted in a cut of some 81% of the NSF FY 1982 budget for educa-

tion, including all of the funds for precollegiate programs) and that the NSF was now very concerned with the integration of research and education and was rethinking the criteria for that reason. Other considerations included the new NSF Strategic Plan, which embraced new long-range goals and core strategies and the Government Performance and Results Act, which emphasized the necessity of linking NSF goals and strategies to results. Surveys of reviewers conducted in 1991 and NSF program officers in 1995 were also important contributors to the decision to reexamine the criteria. These surveys showed that most reviewers ignored at least one of the four criteria, and in those cases, it was much more likely that criteria 3 and 4 (utility and infrastructure), which did not deal with the more technical aspects of the proposal, were the criteria ignored. They also pointed to a lack of understanding of these nontechnical criteria among the reviewers. In addition, a NSF staff committee tasked with looking at the criteria added its view in February 1996 that the criteria needed clarification and should be rewritten (10).

As a result of all these issues and concerns, the four criteria were reduced to two very broad criteria. One focused on the intellectual merit and the quality of the research. The other focused on the broader impacts of the research. This change was not, in the words of NSB chair Richard N. Zare at the press conference announcing the new criteria (24), "any real change." Instead, "it's a great simplification." By reducing the number of questions asked, Zare was optimistic that "we might do a lot better in terms of being able to judge the value of these proposals." It was the expectation of the NSF, as expressed by the then Acting Deputy Director Joseph Bordogna (23, p. 7), that the new criteria were "clearer and easier to apply."

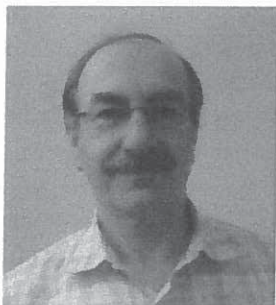
In 2007, the criteria were revised once again, this time to reinforce NSF's interest in transformative research. As far back as 1999, the National Science Board (11) had seen "a need to revitalize a commitment to innovative research." In 2004, a task force was established (13) "to serve as a Board focal point for gaining a better understanding of National Science Foundation (NSF) policies to solicit, identify, and fund innovative, 'potentially transformative' research" (p. v). The report of the

committee came out in May 2007, and at the August Board meeting, approval was given to adding the words “or potentially transformative” to the first merit review criterion. As Director Arden Bement noted (22), this was an enhancement that would result in enhanced support for transformative research, not a radical transformation.

This article is a very quick overview of the changing proposal criteria. There have been four constants in this discussion. Far more worthy proposals are received than are fundable, requiring some criteria to be developed to distinguish among meritorious proposals. Program expansion and external issues have forced the NSF to consider criteria other than simply good science. The peer review community does not necessarily apply the criteria in the manner the NSF wishes. And there are always new programs and new issues forcing the NSF and the NSB to rethink these criteria.

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ABOUT THE AUTHOR



Marc Rothenberg became agency historian for the National Science Foundation in December 2006, after 31 years with the Joseph Henry Papers Project at the Smithsonian Institution. He left the Smithsonian after overseeing the completion of the 11th, and last, volume of the *Papers of Joseph Henry* (Science History Publications/USA, 2007). A historian of astronomy, physics, and American scientific institutions, with publications in such journals as *Historical Records of Australian Science*, *The Astronomical Journal*, *Pacific Science*, *Osiris*, and *The Journal for the History of Astronomy*, Rothenberg also edited *The History of Science in the United States: An Encyclopedia* (Garland, 2001) and *The History of Science and Technology in the United States: A Critical and Selective Bibliography* (2 vol., Garland, 1982–1993).

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