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Revised by Hollander

UNITED STATES NATIONAL SCIENCE FOUNDATION, BROADER IMPACTS MERIT REVIEW CRITERION

In the early twenty-first century, science finds itself caught in a dilemma that is arguably of its own making: its very success in terms of understanding and controlling nature means that it has given birth to powers that transcend the traditional boundaries between science and society. Rather than being viewed as essentially neutral in terms of values, society increasingly views scientific knowledge as leading to various types of winners and losers. The review criteria for US National Science Foundation (NSF) proposals offer an instructive case study of this increasingly prominent dynamic.

BACKGROUND

Established in 1950, NSF is the only US federal agency dedicated to the support of education and basic research across all scientific and engineering disciplines, except for the biomedical sciences, which are handled by the National Institutes of Health (NIH). Although no authoritative definition exits, it is generally agreed that basic scientific research is oriented chiefly toward the discovery and creation of new knowledge, without regard for its eventual employment.

In 1993, Congress passed the Government Performance Results Act (GPRA). The purpose of GPRA was to increase the focus of federal agencies on improving and measuring "results," which would in turn provide congressional decision makers with the data they require to assess the effectiveness and efficiency of federally funded programs. In effect, GPRA sent the message that federal funding is contingent on attaining and demonstrating results. Partly in response to such demands for demonstrable results, in 1995 the NSF adopted a new strategic plan: *NSF in a Changing World*. NSF's new strategic plan included among the long-term goals of the foundation the promotion of the discovery of new "knowledge in service to society."

In 1996, the National Science Board (NSB) established the NSB-NSF Task Force on Merit Review to examine and evaluate NSF's generic merit review criteria, which had been in effect since 1981, in light of the new strategic plan. In its *Discussion Report*, the task force recommended replacing previous review criteria with two simple questions: (1) What is the intellectual merit of the proposed activity? (2) What are the broader impacts of the proposed activity? The simplification was proposed to help connect NSF investments to societal value while preserving an ability to select proposals on the basis of scientific excellence. Such criteria were more clearly related to the goals and strategies of *NSF in a Changing World*. NSF published the recommendations of the task force on the Web, through press releases, and through direct contact with universities and professional associations, and received around three hundred responses from the scientific and engineering community.

In light of these responses, in 1997 the task force published its *Final Recommendations*. The responses raised several concerns about the new criteria, including what the task force termed the issue of *weighting* the criteria:

Criterion 1 was perceived by respondents as more important than criterion 2, or criterion 2 was perceived as irrelevant, ambiguous, or poorly worded. Moreover, respondents expressed concern that for much of basic research it is impossible to make meaningful statements about the potential usefulness of the research. Ultimately, however, the task force recommended that the new criteria be adopted. Later in 1997, NSF issued Important Notice No. 121, which announced NSB approval of the new merit review criteria, effective October 1.

THE NAPA REPORT

In 1998, and again in 1999, Congress directed NSF to contract with the National Academy of Public Administration (NAPA) to review the effects of the changes in NSF's merit review criteria. NAPA is an independent, nonpartisan organization chartered by Congress to help federal, state, and local governments improve their effectiveness, efficiency, and accountability. In 2000, NSF commissioned the NAPA study.

The NAPA study reviewed relevant legislation, reports by external review committees, interviews with NSF personnel, and interviews with members of the scientific and engineering community. In addition, the NAPA study analyzed sample projects funded under both the old and the new criteria, as well as the intentions of those reviewing proposals using the new criteria. Published in February 2001, the NAPA report provides a history of the development of NSF's new merit review criteria, compares the 1997 criteria to the 1981 criteria, and details many of the challenges faced by the merit review process during the period from 1997 to 2000. The NAPA report offers several recommendations to help NSF improve the merit review process, among which is a recommendation to address the "philosophical issues" raised by the new criteria, in particular criterion 2.

The latter recommendation was based in part on NAPA's observation of the diverse interpretations of and reactions to the new merit review criteria among members of the scientific and engineering community. Although the NAPA report fails to delineate explicitly what it considered to be the philosophical issues, it nevertheless provides an excellent source from which those issues can be gleaned. Such issues include:

- Whether criterion 2 is inconsistent with criterion 1.
- Whether criterion 1 is more important than criterion 2.
- Whether criterion 2 is in need of conceptual clarification.
- Whether interpretations of criterion 2 are discipline-dependent.
- Whether reactions to criterion 2 rely on one's conception of scientific inquiry.

These issues are, of course, interrelated. A physicist committed to a strict division between basic and applied scientific research might interpret the criteria as inconsistent, whereas a geologist whose research in plate tectonics might one day lead to predictive capabilities might not. Said geologist might nonetheless view criterion 1 as significantly more important than criterion 2.

CONTINUING ISSUES

Scholars began to pay attention to the issues surrounding the Broader Impacts criterion in 2005 (Holbrook 2005). Among the main issues raised, one in particular—the question of the lack of consistency in the *quality* of responses to the Broader Impacts criterion—stood out. These questions once again led to congressional action. On August 9, 2007, the America COMPETES Act (H.R. 2272) was signed into law (Public Law 110-69). Section 7022 of the act required the director of NSF to issue a report to Congress "on the impact of the broader impacts grant criterion used by the Foundation" within one year of the date of enactment of the act.

On January 4, 2011, the America COMPETES Reauthorization Act of 2010 (H.R. 5116) was signed into law (Public Law 111-358). Section 526 of the law deals explicitly with NSF's Broader Impacts criterion. It is divided into two subsections titled "Goals" and "Policy." The first outlines eight specific national needs that NSF's Broader Impacts criterion is well-suited to address, including increasing the economic competitiveness of the United States, developing a globally competitive workforce, increasing partnerships between academia and industry, increasing the participation of underrepresented groups in science and engineering, increasing national security, improving science education, and enhancing scientific literacy. This list of goals was taken from the report to Congress required by the America COMPETES Act of 2007 (Holbrook 2012).

BROADER IMPACTS 2.0

NSF had also received feedback from members of the scientific community that the Broader Impacts criterion was unclear. This lack of clarity was often cited as a reason for the lack of quality in responses to the criterion. On June 14, 2011, NSB announced new draft criteria for the review of proposals submitted to NSF. The proposed new Broader Impacts criterion would ask, "which national goal (or goals) is (or are) addressed in the proposal?" The complete list of goals is:

- Increased economic competitiveness of the United States.

- Development of a globally competitive STEM [science, technology, engineering, and mathematics] 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.

The most obvious change from the 1997 Broader Impacts criterion is the connection to national goals. By providing a list, NSB could in one fell swoop clarify the criterion, making it easier for proposers and reviewers to respond to and demonstrate the connection between NSF-funded projects and explicit national needs.

Nevertheless, although the proposed criterion did not explicitly state that the list of national goals was exhaustive, worries arose that many proposers and reviewers would assume that the question of "which national goal" the proposal addresses would be answered with reference to that list of national goals. In substituting the list for the vagueness of the "benefit to society" clause contained in the 1997 criterion, the proposed new criterion could limit the freedom of proposers and reviewers to suggest and judge novel and creative ideas not included on the list (Holbrook and Frodeman 2011; Frodeman and Holbrook 2011a and 2011b).

On January 9, 2012, NSB released its final report: *National Science Foundation's Merit Review Criteria: Review and Revisions*. The list of goals was deemphasized, and the vagueness of the Broader Impacts criterion was reemphasized. Effective January 14, 2013, NSF uses the following Merit Review criteria:

> When evaluating NSF proposals, reviewers will be asked to 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 could 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 will be 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.
>
> (NSF 2012, Pt. 1, chap. III, sec. A.2)

These revised criteria strike a balance between the accountability of scientists to society and the autonomy of scientists from society. The criteria both make clear to proposers and reviewers the importance of broader impacts and preserve the ability of scientists to propose creative ideas and to respond to imminent societal needs. As of this writing, it is too early to say whether the 2013 revisions to the merit review criteria will have the desired effect. Congressional pressure for increasing accountability remains strong. Scientists could ease that pressure by owning accountability and providing robust responses to the Broader Impacts criterion.

SEE ALSO *Public Understanding of Science; Transformative Research; Translational Research.*

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UNITED STATES NUCLEAR REGULATORY COMMISSION

SEE *Nuclear Regulatory Commission.*

UNITED STATES OFFICE OF TECHNOLOGY ASSESSMENT

SEE *Technology Assessment Institutions, United States.*

UNITED STATES PUBLIC HEALTH SERVICE

The United States Public Health Service (USPHS) coordinates the country's biomedical research, disease surveillance, and public health initiatives. The USPHS also administers a commissioned corps of over 6,500 health professionals that "protect, promote, and advance the health and safety" of the nation.

USPHS HISTORY

The USPHS traces its origins to 1798, when US President John Adams signed into law measures to provide health benefits for sick and disabled seamen (Mullan 1989). Over the course of the twentieth century, the Public Health Service Act of 1944 and a series of administrative reorganizations resulted in the current USPHS structure and portfolio of programs (Lee et al. 2002). The USPHS includes the following agencies:

- Agency for Healthcare Research and Quality (AHRQ)
- Agency for Toxic Substances and Disease Registry (ATSDR)
- Centers for Disease Control and Prevention (CDC)
- Food and Drug Administration (FDA)
- Health Resources and Services Administration (HRSA)
- Indian Health Service (IHS)
- National Institutes of Health (NIH)
- Substance Abuse and Mental Health Services Administration (SAMHSA).

US AND INTERNATIONAL PUBLIC HEALTH GOVERNANCE FOUNDATIONS

The US Constitution does not explicitly address a right to health care or public health services. Instead, federal statutes authorize the health-related activities of government agencies, and federal funds support public health initiatives or allocate resources to state and local governments. State governments primarily derive their public health authority from the police powers that enable states to act in the interest of public safety, health, and welfare. Examples include the immunization of children, laws that restrict smoking in public, or quarantines that halt the spread of infectious disease.

Internationally, the Constitution of the World Health Organization (WHO) first recognized the notion of a universal right to health in 1946. Subsequent human rights accords, including the Universal Declaration of Human Rights, the European Social Charter, the African Charter on Human and Peoples' Rights, and the American Declaration of the Rights and Duties of Man, reaffirmed this recognition. In some countries, public health is a constitutional right. For example, provisions in the constitutions of Mexico and Panama hold the government responsible for health protection, and the Chilean constitution explicitly enshrines a right to health, even differentiating between individual guarantees and public health.