

Assessing the Broader Impacts of Ecological Research: Towards a “Broader Impacts Impact Factor”

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ABSTRACT: The National Science Foundation requires applicants to describe the “Broader Impacts” of their work, but what truly makes a Broader Impacts activity (BIA) “broad” and “impactful”? I suggest that a “Broader Impacts Impact Factor” could define BIAs’ potential for “impact” and aid comparison of proposed activities during peer review.

KEYWORDS: Broader Impacts criterion, National Science Foundation, outreach, peer review, public dissemination, standardization

1. INTRODUCTION

The National Science Foundation (NSF) currently judges all funding proposals using two review criteria, Intellectual Merit and Broader Impacts (BI). While Intellectual Merit is widely accepted and understood as an inherent characteristic of fund-worthy research, defining, implementing, and evaluating the competitiveness of proposed BI activities has been a continual challenge for NSF and its stakeholders since the criterion debuted in 1997 (National Science Board, 2011).

Through the BI criterion, NSF seeks to improve the technical skills and understanding of the American workforce and to justify public funding by expanding the social relevance and inclusiveness of scientific research. The goals of the BI criterion range from improving national security to supporting education, enhancing public scientific literacy, advancing development of commercial products, and increasing participation of women and underrepresented minorities in science (United States Congress, 2010). At the heart of the criterion is the expectation that scientists not only produce cutting-edge empirical research, but also expand the results of that research to include better informed, better educated, or better-off Americans.

At present, scientists and reviewers feel that competitively addressing the BI criterion is not as straightforward as addressing Intellectual Merit—in part because scientists’ and reviewers’ expertise generally lies only in the subject matter addressed by Intellectual Merit, and in part because no standardizing framework exists for evaluating BI activities (National Science Board, 2011; SRI International, 2011). In a 2010–2011 survey, one anonymous NSF leader observed, “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” (SRI International 2011, p. 65). Given the many activities that a researcher can propose as a BI of their funded project, the ability of reviewers to adequately judge and compare them has been questioned by academics and NSF leaders (Burgren, 2009; SRI International, 2011).

The main challenge for both reviewers and principle investigators lies in quantifying the effects or *value* of different Broader Impacts activities—to determine if they will be, or have been, successful as intended—and to aggregate these evaluation techniques into a standard that is easily comparable across projects and proposals. While the framework for pre- and post-award evaluation of Intellectual Merit is well established (i.e., reviewers rely on scientific expertise and rigor, number/quality of publications, etc.), “proposers and reviewers struggle to find a common understanding or evaluation metric” for BI (National Science Board, 2011, p. 75).

The newest set of NSF proposal submission guidelines, effective February 24, 2014, requires proposers to describe the methods and expected outcomes of their BI activities with greater specificity than ever before, and emphasizes a need for proposers to say how they will measure the success of those activities (National Science Foundation, 2013). For scientists struggling to secure funding, a serious challenge lies in quantifying the effect or value of different Broader Impacts activities—to accommodate requests for more accountability and to enable reviewers to more objectively evaluate the plans and progress described in their proposals.

While guidance from NSF remains sparse on what makes a BI activity truly “broad,” “impactful,” and “effective,” examples from successful outreach programs, cautionary tales, and theoretical work offer some direction (e.g., Cooper et al., 2008; Alpert, 2009; Burggren, 2009; Dickinson et al., 2010; Cronje et al., 2011; Druschke & Seltzer, 2012; Heberlein, 2012). For instance, the Cornell Lab of Ornithology’s >600 existing citizen science programs demonstrate how involving the public in data collection can result both in publishable findings and broader scientific understanding (Dickinson et al., 2010); and collaborations between research centers and museums also indicate the potential for synergies between principal investigators and educators (Alpert, 2009). These citizen science endeavors and relationships between principal investigators and informal science education centers both exemplify successful and effective BI.

Presently, the factors that can *explain* the success of these endeavors have yet to be synthesized to guide “best practices” in BI development and evaluation during the NSF proposal and review process. The varied experiences of social psychologists, professional communicators, graphic designers, and education specialists during these outreach projects can clarify core values and common techniques for the scientific community, and could in future make the BI criterion as straightforward to address as Intellectual Merit. I suggest that a standardizing framework of characteristics, which I call a “Broader Impacts Impact Factor” (BIIF), if further developed and adopted by NSF, could help compare proposed Broader Impacts activities and assess the potential strength of their impact.

2. A STANDARDIZING FRAMEWORK FOR BI

The Broader Impacts criterion is vast to say to the least, and so I have chosen to consider, as a reasonable and manageable place to start developing the BIIF, BI activities in one area of the criterion’s suite of goals: dissemination of research findings (e.g., outreach or increasing public scientific literacy). Dissemination of research findings to increase scientific literacy is the third most proposed Broader Impacts activity across all NSF directorates, featuring in slightly more than 20% of proposals (teaching/training ranks first with over 60%, and broadening participation of women and underrepresented groups ranks second with about 25%; National

Science Board, 2011). The proportion of proposals that include dissemination is slightly greater (nearly 30%) in the Biological Sciences directorate (National Science Board, 2011).

There are many different outreach activities that could be proposed as a BI of a scientific research project in the Biological Sciences directorate. Researchers studying bird migration and physiology (my area of research), for example, might propose activities that engage citizen scientists in data collection, bring their science to Audubon workshops, or detail the results of their work online or in non-scientific publications. If competing proposals, with equally high-scoring Intellectual Merit, suggest these different activities, how might a reviewer best judge between them, or determine if any of the activities are likely to be “impactful” at all?

A reviewer could examine audience size, or how far outside of academia that audience might be, but those metrics do not lend insight into the *quality* of the experience that audience receives (Nadkarni & Stasch, 2013). Additionally, such an approach does not consider whether the activity takes a deficit- or contextual-model approach to knowledge building (Gross, 1994), or if the activity specifically relates to an identified public need or appeals to established public attitudes. Successful, i.e., “impactful,” outreach or dissemination projects—ones that achieve the societal outcomes that they proposed, no matter what their activities were—demonstrate that their organizers understand these principles. Essentially, qualities that define the “best” Broader Impacts activities can be displayed by any communication or outreach activity, regardless of the form it takes. If they are identified and summarized, NSF can use them to better gauge proposals’ potential for impact.

Returning to the bird study examples above, the proposers might state (because reviewers would want to know) whether their proposed BI activity (1) targets a specific audience that can make explicit use of the proffered research-generated information, (2) has any potential for domino impacts through non-target audiences (e.g., if the target audiences are educators or policymakers or wildlife managers), or (3) integrates with existing outreach programs with diverse expertise. Scientists should consider these factors if they are to plan properly for success; and discussion of these aspects would likely help reviewers compare proposals if they were addressed in proposal descriptions. Any of the activities mentioned above—citizen data collection, public lectures, online publication—*could* be “impactful” *if* their proposers addressed the above three points, among others, explicitly.

Based in part on the analyses of Nadkarni and Stasch (2013), theoretical work (e.g., Burggren, 2009) and “best practices” in outreach efforts used by ecologists (e.g., Dickinson & Bonney, 2012), I am working to identify characteristics of successful outreach programs, and core qualities of outreach methods, that principal investigators and reviewers should consider when formulating or comparing BI activities. I expect that these descriptors, and a discussion of their relevance to case studies of successful outreach, will aid the development of a BIIF, which NSF might implement to evaluate a range of BI activities.

3. CONCLUSION

The qualities that make a BI outreach effort truly “broad” and “impactful” have yet to be adequately described. Since the criterion’s inception, evaluation of BI activities has been based on a set of vague values that have not been adequately recognized in guidance documents, because they are not as embedded in the scientific culture as those values that inform judgment of Intellectual Merit. The Broader Impacts criterion by its nature forces scientists to work

outside of their empirical comfort zone, and that presents a methodological challenge that hinders fulfillment of the criterion's admirable goals. Taking an interdisciplinary look at the underlying characteristics of successful outreach programs can provide guidance for scientists, by elucidating the core values reviewers should be looking for in proposed BI activities. A Broader Impacts Impact Factor, or variation thereof, could make the values and outcomes of proposed BI activities more easily comparable among different proposals.

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