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Producing Knowledge: The Social Made Visible in the Division of Environmental Biology of the National Science Foundation

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PRODUCING KNOWLEDGE:

THE SOCIAL MADE VISIBLE IN THE DIVISION OF ENVIRONMENTAL BIOLOGY OF

THE NATIONAL SCIENCE FOUNDATION

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PIM 74

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To PIM 74/MAT 46. Thank you for the wonderful year of community on a hill in Vermont!

To Laura. Thank you for the wonderful year of support in the city!

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ABSTRACT

This inquiry explores how knowledge is produced in the Division of Environmental Biology (DEB) of the National Science Foundation. Beginning from a poststructuralist understanding of science as firmly embedded in the unequal relations of society, this study sought to examine how the policies and procedures of funding research proposals in DEB influence and are influenced by those relations. Using an institutional ethnography approach to analysis, data were collected from analyzing publicly available texts from the division, NSF, Congress, the Office of Management and Budget, and the research community. The analysis demonstrates how the activities of DEB could maintain or exacerbate inequality in the absence of critical engagement with the ruling relations present in the Division's processes. The inquiry suggests opportunities for federal funders of science to ensure their work is oriented toward confronting inequality and creating social justice.

Introduction

The Division of Environmental Biology (DEB) of the National Science Foundation (NSF) supports basic research to better understand how our environment came to be, how it functions, and how it changes. This is important work as we face challenges, such as human-caused climate change, at the same time as we develop tools to interact with the environment on levels not previously possible, such as genetically modifying entire mosquito populations in the wild. Acknowledging the possibilities of this work, scholars in Science and Technology Studies and Feminist Science Studies point out that science is firmly embedded in the unequal relations of the society it operates in and, without engaging critically with the presence of those ruling relations, could work to maintain or exacerbate injustice. As such, if leaders in the field want to ensure their work is oriented toward creating more equitable realities, it is imperative that they reflect critically on the social relations involved in their science and incorporate that understanding into processes and procedures for producing knowledge.

In doing this inquiry to facilitate critical engagement with ruling relations in the Division of Environmental Biology, I relied on an institutional ethnography approach to explore how knowledge is produced. In this paper, I outline the actualities of people's doings in relation to DEB's work. I then examine how those doings are coordinated through institutional texts and regulatory frames that people work in relation to and map the ruling relations involved in holding them accountable to that. I trace the points in the process where the particularities of people get translated into institutionally actionable concepts that make inequality invisible. Finally, I present opportunities to use the critical map of coordination I discovered to alter the processes in DEB to promote the progress of doing science to challenge inequality and create social justice.

Background

  The National Science Foundation, by providing federal funding for basic research and making decisions about what research to fund, represents a critical site to glimpse the forces at play in the production of knowledge. I first became interested in the organization after getting a job in the Division of Environmental Biology. I wanted to understand the relationship between my work supporting the funding of basic science and the knowledge that is produced, valued, and held to be true in society. Most federal agencies have restrictions on being employed by them and doing research on them. As such, I have been careful not to rely on my experience working at NSF for this research, and instead focused on analysis of publicly available data sources. Importantly, however, there are a number of factors independent of my experience that make DEB an ideal organization in NSF to begin a study of the social aspect of knowledge production.

  DEB plays an important role in the disciplines it supports and it is more accessible to research than most divisions in NSF. According to NSF's fiscal year 2016 budget request to Congress, DEB's estimated funding for research and related activities in fiscal year 2015 was $143.49 million, and the Directorate for Biological Sciences that DEB belongs to "provides about 66 percent of the federal funding for non-medical, basic research at academic institutions in the life sciences" (NSF, 2016a, p. BIO-2). Given the important role that DEB plays in its related disciplines, it is a model organization to explore how knowledge is produced in a national-level process. Another key reason for choosing DEB for this study is that it was the first division in NSF to create a blog to communicate with their research community (DEB Science Staff, 2013a). The blog, *DEBrief*, departs from the ordinarily institutional policy heavy public documents of NSF and has a number of posts that detail the day-to-day activities and experiential

work knowledge of staff members. This offers a great starting point for examining the social relations present in the work.

The 22 scientific staff members in DEB, each with a PhD and at least six years of independent research experience, are tasked with representing and involving their intellectual communities in deciding which research proposals to fund (NSF, n.d.). According to DEB Science Staff (2015a), these staff reviewed 1590 preliminary proposals and 510 full proposals in Fiscal Year 2015, but made awards to only 131 projects. With a success rate of 7.6%, for projects submitted to DEB, making those decisions is a major task. As a result, DEB scientific staff spend a significant amount of time making decisions that shape the production of knowledge. In this inquiry, I sought to understand how the process of making those decisions is affected by social relations of power and how they in turn impact those relations. This allowed me to explore the larger social context of ruling relations that are intimately tied to the work DEB does. It also made it possible for me to consider the barriers and opportunities there are for encouraging critical reflection of the role of unequal social relations in the sciences.

The Inquiry Question

Primary Inquiry Question: How is knowledge produced in the Division of Environmental Biology of the National Science Foundation?

Sub-Components

1. What are people involved in the Division of Environmental Biology actually doing?

2. How are people in DEB's doings coordinated to produce knowledge?

3. What are the ruling relations involved in the way people's doings are coordinated in DEB?

4. What opportunities and challenges are there for encouraging critical engagement with the social coordination of science in the Division of Environmental Biology?

Literature Review

There is a large, contentious literature on the production of knowledge and its relation to society. For the purposes of this inquiry, Michel Foucault's work offers a useful starting point. Foucault (1980) stated that "truth is a thing of this world," and it is "centred on the form of scientific discourse and the institutions which produce it" (p. 131). By these words, and the emphasis he put on viewing knowledge through the relations of power that produce both it and the people who hold it to be true, Foucault was able to trace the origin of consequential attitudes and actions in regards to sexuality, psychiatry, and discipline to historical conditions and power relations. Foucault encouraged people to break with conceptions of power as only oppressive force, and think of it as something that "traverses and produces things, it induces pleasure, forms knowledge, produces discourse" (Foucault, 1980, p. 119). To explain how this happens, he described a "regime of truth" or a "general politics of truth" that operates in a society and includes: "the types of discourse which it accepts and makes function as true; the mechanisms and instances which enable one to distinguish true and false statements, the means by which each is sanctioned; the techniques and procedures accorded value in the acquisition of truth; the status of those who are charged with saying what counts as true." (Foucault, 1980, p. 131). This framework for investigating how knowledge is shaped by the social has enabled people to critically deconstruct a wide variety of what is taken for granted in society.

Foucault did not see the relationship between power and knowledge as only going in one direction. His English language translations have used the term 'power/knowledge' (Foucault, 1980), to describe the concept that knowledge produces unequal social relations at the same time as it is produced by those relations. The mechanism Foucault described for this linkage is complex. He describes a circular relation between institutions, rules that govern the production

and distribution of knowledge or what is regarded as truth, and produced discourses that feed

back to strengthen or weaken the system. Foucault (1979) stated that, "it is in discourse that

power and knowledge are joined together" (p. 100) and "discourse transmits and produces

power; it reinforces it, but also undermines and exposes it, renders it fragile and makes it

possible to thwart it" (p. 101). This opens an avenue for intellectuals and those involved in the

knowledge producing regime to remake the regime of truth to confront unjust power relations

and social inequality.

Trying to understand how knowledge is produced has spawned a diverse enterprise that

spans methods for tracing the origin of widely held beliefs, methodologies for analyzing

discourses and the social relations that accompany them, and ontologies for generating

knowledge from the standpoint of ordinary people's activities. One relevant tradition to the goals

of this inquiry is ethnographic research on how knowledge is produced in scientific disciplines.

Latour and Woolgar (1979) wrote that their interest in a two year anthropological study of the

Salk Institute for Biological studies, was to discover "the way in which the daily activities of

working scientists lead to the construction of scientific facts" (p. 40). Their work offered a

detailed analysis of that process and created opportunities to engage with those findings to

strengthen the reflexivity of science in that discipline. Science and Technology Studies (STS)

scholars through this kind of work, Latour (1999) said, "pride themselves on extending the

scientific outlook to science itself" (p. 2). Most of the ethnographic work related to exploring

how knowledge is produced in scientific disciplines focuses on the process of research and the

context of labs or universities. Research into the production of knowledge at the National

Science Foundation or another national-level funding organization is limited in this regard and

represents an opportunity to engage with a higher-level organizing process and a greater

opportunity for impact by enhancing the responsiveness of the organization.

Contrasting with their hope of developing a more reflexive science with their methods,

STS scholars have been alarmed that the very same methods they use for deconstructing the

production of facts in science have been co-opted by climate deniers and anti-evolutionists.

Latour wrote, "Dangerous extremists are using the very same argument of social construction to

destroy hard-won evidence that could save our lives" (2004, p. 227). Within the National Science

Foundation, this represents a serious concern as both social science and climate change research

face political scrutiny from some members of Congress (Walsh, 2013). However, Latour (2004)

claimed that it is possible to reinvigorate criticism, with care, to see that it adds rather than

subtracts from hard-won evidence. Navigating this fear, that opening a scientific discipline up to

engage with the ruling social relations involved will undermine it, is a key challenge in research

into how knowledge is produced.

In exploring how unequal social relations and the production of knowledge are linked,

Sociologists, Science and Technology Studies scholars, and Feminist Science Studies scholars

have all stressed the importance of engaging with subjectivity in the production of knowledge

(Merton, 1973; Harding, 1991; Latour, 1999). Haraway stated that the object of study is

produced by the subjective position of those studying it (1988). This concept has been especially

important in feminist scholarship. Dorothy Smith (2005) wrote that men in academia created a

false universality to their work by concealing the dominant masculinity of traditional intellectual

agency through separating the mind and thought from the body. Feminist scholars have refused

to separate the mind from the body and have not portrayed this as a weakness. Haraway stated

that starting from the 'situated knowledges' or 'partial perspectives' of women and communities

of people in different positions in relations of power, if dealt with appropriately, offer hope for producing knowledge that is more accountable to reality (Haraway, 1988).

Translating the perspective of the importance of engaging with subjectivity to the people trained in the natural sciences can be difficult. MacMynowski (2007) described the tension between objectivity and subjectivity as a key sticking point in fostering more interdisciplinary environmental research involving social and biophysical sciences. In working to overcome that, Latour (1999) has written extensively on how natural sciences can incorporate working with subjectivity to strengthen scientific efforts. He stated that Science Studies scholars "may be the first to have found a way to free the sciences from politics" (p. 22). While this may be an attractive way to overcome the tension of the Science Wars, Feminist Science Studies scholars, like Haraway (1988), have argued that science cannot be freed from politics, as it will always be political by virtue of who is doing it and the relations involved.

The more traditional approach to critical reflection within scientific disciplines has been to look at biases and threats to validity prevalent in how they function. Some major examples include: concerns over reproducibility (Open Science Collaboration, 2015), confirmation bias and P-hacking (Nuzzo, 2015), bias resulting from the reward structure of publication (Chambers, 2014), and declines in funding. Efforts to overcome these biases can be creative and reflexive, such as crowdsourcing research with multiple teams analyzing the same dataset to improve validity (Silberzahn & Uhlmann, 2015). In thinking about these efforts, it is important to acknowledge that science is often unfairly homogenized (Pedynowski, 2003), and efforts to overcome these biases should consider the context of each discipline. Even so, admitting the context of publications or tenure pressures will only go so far in creating a more reflexive and valid scientific effort. Without engaging with the larger context of unequal social relations, the

work won't address the issues and opportunities detailed by Science and Technology scholars and others.

The National Science Foundation is in a position to broaden the scope of critical reflection in scientific disciplines and significantly influence the reality of science and the production of knowledge. The organization has made many recent efforts to impact the relationship of science and society through: the introduction of the Broader Impacts criterion for proposal review, the work-life balance initiative to increase the participation and advancement of women, broadening participation initiatives to increase participation of underrepresented groups in science, and promoting data management policy requirements (NSF, n.d.). These efforts address some of the obvious ways certain people are excluded from "succeeding" in science due to the particularities of their experiences. However, they focus more on who is involved in the process rather than how the process fundamentally operates and how that affects who can be involved. The merit review process and related policies, that guide how proposals are reviewed and grants are awarded at NSF, are of greater interest to engaging with more fundamental social relations in the production of knowledge.

The NSF (2015) publishes a report to the National Science Board on the merit review process each fiscal year. The report describes the merit review process, the outcomes, and information on merit review pilots. However, the report does not critically examine the relationship between NSF's processes for reviewing proposals and the larger social context. For example, the report states, "The proportion of submissions from under-represented racial and ethnic groups in FY 2014 (8.2%) is smaller than their representations in the U.S. population but is similar to their representation in the full-time faculty of academic institutions (8.3%)" (NSF, 2015). Because NSF primarily supports basic research done by academic faculty, this could be

interpreted as evidence that NSF is appropriately involving all racial groups in their sphere of

work. It could be argued that NSF is not responsible for the larger issues of inequality,

discrimination, and structural violence that give rise to the racial imbalance in academic faculty.

However, this would ignore the very real possibility that NSF could be maintaining or worsening

that inequality by ignoring the larger context of inequality and reviewing proposals on their

"merit" in a vacuum. Additionally, this demonstrates the need to critically investigate how NSF's

policies and procedures both are produced by that larger context of inequality and also feed back

into it to maintain, worsen, or combat it.

  Studying NSF's merit review process and activities that produce knowledge from a

sociological lens is notoriously difficult. The only study to explore the experiences and activities

of NSF staff in the review process through in-depth interview was prepared for the National

Academy of Sciences (Cole, Rubin, & Cole, 1978). They conducted the research in response to

criticism from the House Subcommittee on Science, Research, and Technology that the NSF

merit review process was an "incestuous buddy system" and an "old boys system" (US Congress

House Committee on Science and Technology, p. 40, 1976). The authors of the response report

presented analysis and quotes about bias in the funding decision process from interviews with 35

former and active program directors and quantitative analysis related to testing the 'old boys

hypothesis' (Cole, Rubin, & Cole, 1978, p. 18). Their analysis, while interesting, lacked a critical

lens that could have explicitly connected the bias with inequality and power relations in society.

While the kind of access they were afforded is unlikely to be granted these days without a similar

level of pressure from Congress and the public, the public texts that describe NSF's funding

decision process and the DEB blog provide enough of an entry point to investigate the social

relations that are present in the process today.

Inquiry Methodology

Approach and Rationale

For this inquiry, in order to go beyond the activities that take place in DEB to understand how they are coordinated and knowledge is produced, I used an approach based on Dorothy Smith's (2005) conception of institutional ethnography. Institutional ethnography is an ontology, or theory of reality, of the social as that which coordinates the activities of people. By defining the social in that way, Smith argues that inquiry can begin from the actuality of what people are doing and move to examine the ruling relations that coordinate them. I began this inquiry with an explicit concern based on poststructuralist theory that the Division of Environmental Biology's work is tied up in the social reproduction of inequality and the individuals making funding decisions are themselves produced by unequal social relations. However, the institutional ethnography approach allowed me to make visible the social reproduction of inequality in the actual coordination of activities, rather than in an imposition of a theoretical conception of what might be occurring that would objectify the people of concern.

The basic framework for doing institutional ethnography that Smith (2005) lays out is to start with the actuality of people's doings, look for the coordination of those doings, and explicate the ruling relations involved in that coordination. Smith argues in her outline of institutional ethnography that "institutions and ruling relations in general are mediated by texts" (2005, p. 86). Therefore, I primarily analyzed publicly available texts related to the work of the Division of Environmental Biology of NSF to map the coordination of work and the ruling relations involved. I was able to explore the actualities of people's doings using the experiential descriptions of work from the DEB blog. In doing this, I hoped to make the knowledge produced

in this inquiry accountable to the people involved in producing knowledge in DEB and to those impacted by it.

Data Gathering Methods

For the institutional ethnographic analysis of DEB, I needed to gather data on the actualities of people's doings and on the textual coordination of work. Due to the restrictions on using my status as an employee to do research on NSF, I was not able to interview DEB staff, use observations from my work, or use any other information that I would have privileges access to as data. To collect data on the actualities of work, therefore, I turned to the public DEB blog, *DEBrief*, available at nsfdeb.wordpress.com. *DEBrief* has 39 posts to date tagged "DEB Explained" and 23 posts tagged "Meet DEB". Many of those overlap, but there is a good amount of description of the day-to-day activities that take place in DEB and 17 interview-type posts where individual staff members responded to questions about their work. Though the standpoint for this research was primarily based on the activities within DEB as the entry point, I also used descriptions of the tenure system, grant application process, research lab management, and teaching responsibilities from blogs by academic faculty in Environmental Biology and other disciplines to get a sense of the actualities of writing a research proposals. Some blogs I used include: smallpondscience.com and dynamicecology.wordpress.com. For a step-by-step recounting of the grant application process I relied on a post on pgbovine.net entitled "Writing an NSF Grant Proposal: A First-Timer's Perspective" (Guo, 2014).

For data on the textual coordination of the work described in DEB, I turned to publicly available texts from the external facing www.nsf.gov website. Smith defines texts as "materially replicable words or images" (2005, p. 86). For this research, I focused primarily on the written documents available on the website. Texts are especially important for investigating the

problematic of how knowledge is socially produced in an organization like DEB because, as

Smith writes, the characteristic forms of knowledge are textual and they "bear and replicate

social relations" (2005, p. 27). The main texts that I analyzed as institutional texts coordinating

people's doings were: the Proposal and Award Policies and Procedures Guide, DEB and related

NSF funding solicitations, DEB awards, Committee of Visitors (COV) reports, public Merit

Review Process Reports to the National Science Board, NSF appropriations and other

congressional hearings and reports, and additional posts on the *DEBrief* blog. This gave me a

collection of data related to both the actualities of people's work in DEB and the coordination of

that work.

Data Analysis Methods

In analyzing the data, I followed the method described in Smith's (2005) framework for

doing institutional ethnography. I first explicated the actuality of people's doings from the

experiential descriptions in the *DEBrief* posts detailing day-to-day activities. Institutional

ethnography treats texts as coordinators of people's doings, so I then followed from that to look

for the coordination of those actualities in the texts related to DEB that were publicly available

online. I explicated the hierarchy of texts and the regulatory frames that serve to define the

concepts that are the basis for institutional action. According to an institutional ethnography

approach, the categories and concepts that the texts set forth as what DEB can take action on are

the means for translating the particularities of people's situations into an institutional reality. I

used the disjuncture between people's everyday experiences and the categories specified by and

used in that textual coordination of institutional action to show the particularities of people's

experiences that are made invisible in the process. I then mapped the trans-local ruling relations

interacting with the institutional discourse to make visible the social, as defined by Smith (2005), in the coordination of activities and to locate possible sites for progressive change.

To organize the data from diverse and large texts I used a qualitative text analysis technique based on Hesse-Biber and Leavy (2011). I coded each line of texts I reviewed, created memos, identified themes, and worked to develop features of the discourse and relations coordinating actions in DEB. To put the data together into a map of ruling, I conducted secondary coding and grouping of codes to connect the major coordinating features of the texts and the relations present in them to people's actual doings.

Ethical Considerations

In doing this research I could not, and did not, rely on my status as an employee of NSF to conduct research. Everything I did for the inquiry had to be something that any interested person could do or replicate. I was also aware of efforts undertaken by corporate leaders to undermine perceptions of climate change and social science research as reliable in order to benefit their interests. I did not want to contribute to their efforts to de-motivate people from making changes that could better people's lives. However, producing knowledge without critical reflection of the social relations involved in it could have the same impact by exacerbating inequality. Therefore, investigating the social coordination of how knowledge is produced is an important aspect of strengthening the accountability of the knowledge producing system to the reality of people's lives.

Notes on the Inquiry

This study is qualitative. It is not meant to test hypotheses or theory. In doing it, I sought to make visible processes that maintain and exacerbate unequal relations in society. One key limitation is in the data I used to investigate actualities of people's doings. Due to restrictions on

interviewing program officers at NSF and on using observations that I gained privileged access

to through my employment, I was not able to begin the inquiry from a dialogue with people's

actual experiences in the organization. However, from the actualities described in public posts

online, I was able to begin from experiential text. I invite people reading this report to take part

in the analysis and consideration of how the production of knowledge is organized and the ruling

relations that are involved in that.

<div align="center">**Analysis**</div>

Actuality of people's doings

   The main organizing function of the Division of Environmental Biology, and NSF in

general, is receiving research proposals and deciding which ones to fund. One person working in

DEB as a AAAS fellow that has an interview posted on the *DEBrief* blog wrote of the process,

"before coming to NSF, large federal funding agencies seemed mysterious to me: proposals went

in, and either acceptance or rejection letters came out" (DEB Science Staff, 2014a). In order to

de-mystify the process, I analyzed several blog accounts of the actualities from the point of view

of someone applying for a grant and from the point of view of DEB staff.

The Proposer's Experience

   Philip Guo wrote an account of writing an NSF Grant Proposal for the first time on his

blog (2014). Though he is an Assistant Professor of Computer Science, his account of the

application process is very detailed and the major features match those of the Ecology and

Evolution faculty blogs that contained less detail. The first thing Philip writes is that applying for

grants for him is a vital part of the process of getting tenure. For him, and most of the bloggers in

the Ecology and Evolutionary Biology field, that process of getting tenure began with a PhD

education, postdoc position, and finally getting hired as an Assistant Professor. In a post on the

economics of sustaining that position, he writes that he was given a startup package to begin a lab, buy equipment, and support students and personnel in it. He described this startup funding as lasting 2-3 years. From there it was up to him to secure a grant of several hundred thousand dollars a year to continue the research work until his tenure hearing that relied on output from that work. One of the reasons he cites that he needs that amount is because he needs to double any money that he requests due to the approximately 50% take by the institution for "indirect costs". See *Figure 1* below for the diagram of the relationship between grants and getting tenure that Philip included with his post.
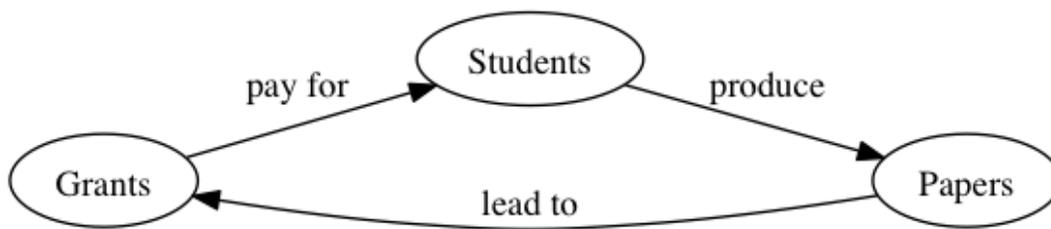

Figure 1. The economic engine of an academic research lab (Guo, 2014).

Philip went on in his blog post to describe eight weeks of intensive preparation of his grant application. This preparation included reaching out to NSF staff for advice (some returned his call and some did not), working with his university to get help with the paperwork for the application (which was complicated by a staff member going on vacation), reading NSF's guidelines, reading colleague's proposals as examples, putting together preliminary results, and writing the proposal for weeks. All of this had to be done in concert with the teaching and administrative responsibilities of the position. This presents a picture of a very time intensive and high-stakes process from the point of view of the researcher. However, this only includes the responsibilities that have been labelled "work" by Philip's employer.

The actual picture includes all the activities that enabled Philip to do his grant application. Smith (2005) writes that for institutional ethnographers, "'work' is used in a generous

sense to extend to anything done by people that takes time and effort, that they mean to do, that is done under definite conditions and with whatever means and tools, and that they may have to think about" (pp. 151-152). Philip himself pointed to this issue in another post entitled, "How my mother made tenure" (Guo, 2014). In that post he detailed his mother's daily schedule as a pre-tenure assistant professor for six years that included all the challenges of the job along with the work of raising her children, preparing meals, and teaching extra classes to make enough money to support the family. This account highlights the obvious and important point that the preparation of research grants is not something that happens in a vacuum of professional, academic life. It relies on having the time, support, and circumstances that make it possible to write a quality grant, and those factors vary, and are affected by other factors, particular to each person interested in research support.

There are a variety of experiences and circumstances that other bloggers describe as central to their experience of applying for NSF grants. Some are in "soft-money positions" that require them to get grants to fund their own salaries (Strassman, 2015). Others are at primarily undergraduate institutions or "minority-serving institutions" (McGlynn, 2013). However, even the variety of experiences of academic researchers doesn't compare to the variety in the actualities of all people engaged in the general effort of producing knowledge about how the environment came to be and functions. That group spans approaches to producing knowledge outside of what is traditionally labelled as science to include Indigenous epistemologies and environmental activism. All of the particularities of the experiences of people engaged in producing knowledge in the realm of environmental biology are important factors to consider in how they affect the experience of applying for research support and how they are subsequently treated or ignored by the coordination of activities in DEB.

The Review Process

The posts on the *DEBrief* blog contain a lot of description of the day-to-day work that takes place in the division beyond the general description of procedures available in the NSF Grant Proposal Guide. While I wasn't able to interview DEB staff to dialogue about the actuality of what they do from their standpoint, there is enough data in these posts to get a sense of the work from the staff position. Additionally, there is a series of "Meet DEB" interviews with DEB staff posted. In those, some people were asked what they do at NSF and some answered descriptively, thus giving a hint at their experiential work knowledge from their standpoint.

The overall view from the NSF Grant Proposal Guide is that institutions generally submit proposals that researchers have prepared in response to an NSF program solicitation. Then NSF staff members that have been designated "program officers" for that program receive the proposals, check them for compliance with the requirements of the solicitation, and seek external review input from experts in the field. They get that advice through ad hoc reviews and panels and then analyze it before making a recommendation for funding to their Division Director. NSF provides a diagram of that process in the Grant Proposal Guide:
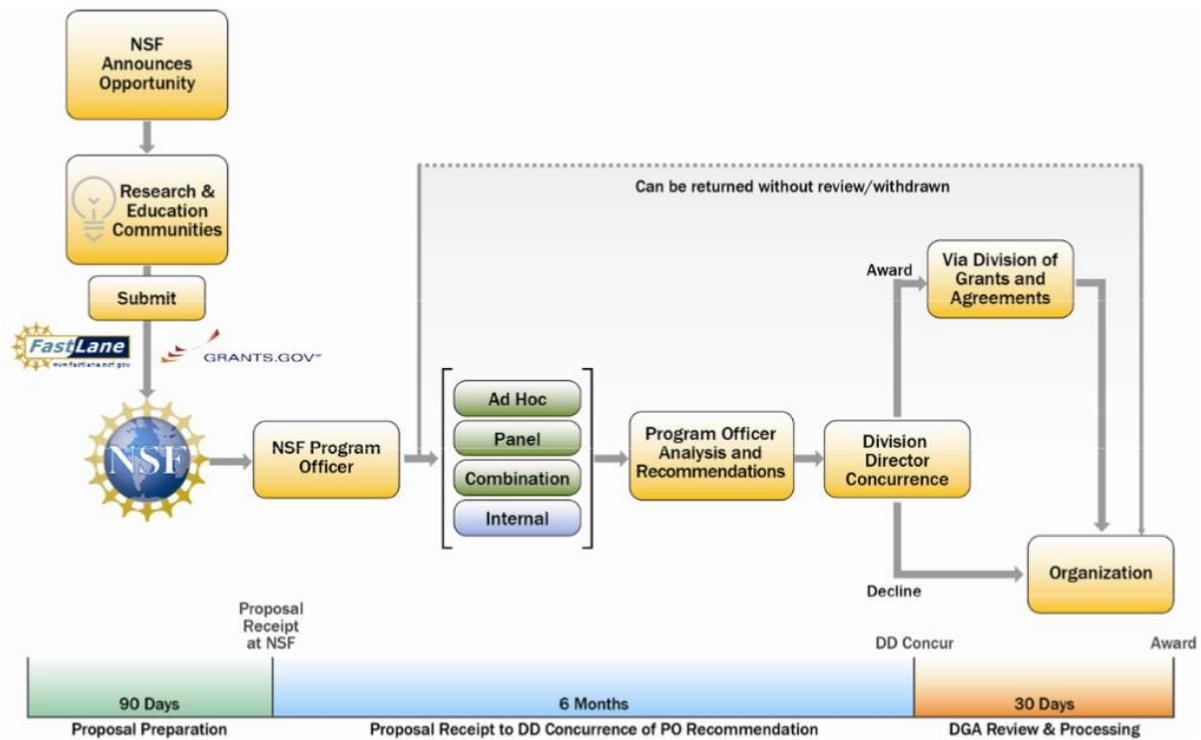
Figure 2. NSF Proposal & Award Process & Timeline (NSF, GPG, Exhibit III-1)

The *DEBrief* blog posts that explain the review process provide a depth of what those steps actually entail for the staff. For compliance checking, the information is sparse, they just mention that they have to read through each individual proposal jacket to make sure proposals meet the program requirements. For ad hoc review and panel review of proposals however, there are pages of details on how they go about selecting reviewers and reaching out to them to review proposals. The DEB review process is slightly modified in the sense that they have added a pre-proposal phase to their core programs to cut down on work "in the face of increasing proposal submissions, increasing project costs, and flat program budgets" (DEB Science Staff, 2013b).

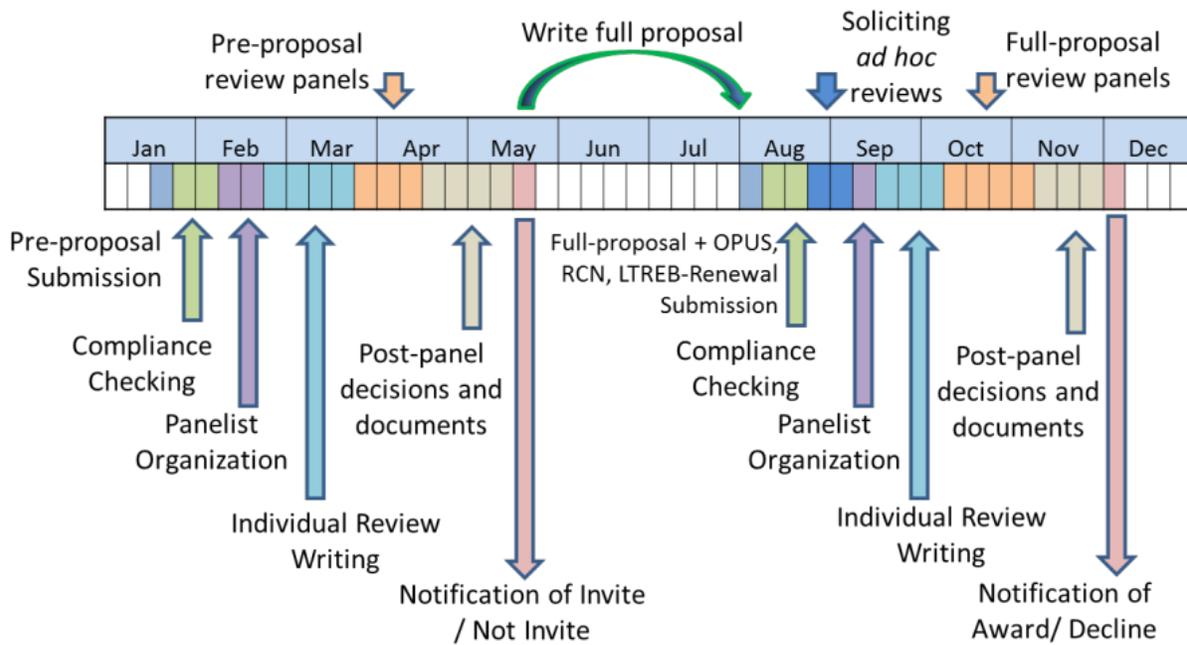See below for the timeline of the review process specific to DEB posted on *DEBrief*:

Figure 3. Timeline of DEB activities in relation to proposal review (Source: DEB Science Staff).

On *DEBrief,* several posts focus on the difficulty of identifying reviewers for ad hoc and panel review. For each full proposal, of which there were 510 in FY 2014, one post says they request "at least 6 ad hoc reviews," and expect to get three responses back. To identify these people to request review service, DEB staff say that program officers can often think of "a few highly appropriate reviewers for any given proposal they are managing simply because they know the literature and lots of scientists in the field" (DEB Science Staff, 2014b). However, they say this is rarely enough, and to find the rest they search Google, Google Scholar, or another page for the descriptors from a proposal. The people that show up at the top of the search result for those keywords are the list they start with. After that they look through the hyperlinks that came up to see if that person has recent publications or an active lab. As they put it, "you may come up at the top of the results but if those results look like an online ghost town, we'll be skipping down to the next name on the list" (DEB Science Staff, 2014b).

DEB staff describe the process of finding panelists as slightly different. For that they ask people who have already served on panels or have an award from DEB to be on the panel. Outside of that they rely on suggestions from other reviewers or program officers. In organizing the panel they discuss the need to plan it six months in advance because of the difficulty of securing a room and administrative services that are shared with all other programs in NSF. Given the pressure to recruit a large number of reviewers that meet the criteria of "expertise, interest, and lack of conflicts," the actuality of the process described is one of filling the "reviewer" slots with people they know or know the reputation of. This can be a time consuming activity. One program officer put it in an interview posted on *DEBrief* when asked what he does at NSF, "*Ad hoc*, *ad hoc*, and *ad hoc*: i.e., get proposals reviewed" (DEB Science Staff, 2014c).

After getting ad hoc and panel review input, the program officers then need to make a recommendation about which proposals to fund. As stated earlier, in FY 2015, DEB reviewed 1590 preliminary proposals and 510 full proposals. From there, they made awards to only 131 projects, for an overall reported project success rate of 7.6%. This means that the vast majority of their decisions are to decline, while, according to another *DEBrief* post, the majority of full proposal panel recommendations are in the "good" categories of funding at a High, Medium, or Low priority (DEB Science Staff, 2016). To make the final recommendations, DEB staff say they take into account "portfolio balance" based on diversity of awards, career stages, demographics, geographic regions, institutions, topics, lab status, and risk. However, they also say that, "the recommendations of the reviewers are by far the most important factor; the best of the best are likely to be funded" (2014b). After the "best" are funded, then issues of portfolio balance enter into consideration for funding decisions.

In addition to this review process, the staff of DEB are also making decisions about who becomes DEB program officers. NSF has a rotator system for many of their program officer positions, so they are typically only on board for a year or two before they are replaced (DEB Science Staff, 2014d). The required qualifications for candidates to be considered for program officer positions are: "a Ph.D. in biology or a related field… plus after award of the Ph.D., six or more years of successful research, research administration, and/or managerial experience in this scientific area" (USAJOBS, 2014) This threshold to become a program officer means that the subsequent activities of seeking out reviewers relies heavily on the network that the people that are hired made in their experiences before going to NSF.

Coordination of Activities

The actualities of what people are doing situates us to the time and place where their activities take place, but knowing what they are doing is not the goal of this study. The object of this analysis is the coordination of those activities, which will lead to knowledge of the ruling relations involved. There is a great deal of theoretical background to think about how that coordination takes place in actor-network theories or in poststructuralist conceptions of discourse. However, to make the analysis accountable to the people of concern within the process, I needed to make that coordination accessible to observation. Smith (2005) argues that this can be done in institutional forms of coordinating people's activities because that coordination is mediated by texts.

The coordination of activities by institutional texts relies on the distinct way that they create a shared reference space. This reference space is a version of what Vološinov put forward as "interindividual territory" (1973). Interindividual territory is that which is created in conversation to make shared sense of what is being communicated. Words become objects that

refer to shared conceptions of reality. The same kind of conversation takes place when people read, hear, or view text in the sense that there is what Smith calls a "text-reader conversation" (2005). The experiential texts that I presented in the previous section described Google searching for names or asking a colleague for help but being told they will be on vacation. In reading those accounts, the reference for the "interindividual territory" in the text-reader conversation is drawing from my own experience.

In institutional texts, the reference for that "interindividual territory" does not exist in someone's experience, but rather exists only in the texts. For example, the panel review summary template (see Appendix A) that DEB staff posted on the *DEBrief* blog (2015b), asks panelists to list the strengths and weaknesses of a proposal on the "intellectual merit" criteria. To have that shared conversation, a panelist needs to share a conception of "intellectual merit" with the text. The reference for that criteria leads panelists to respond to the intellectual merit criteria within NSF texts which were originally conceived with an expectation for people to respond to it in a certain way. And if the panelists demonstrate a different conception of that criteria, the *DEBrief* blog post on panel summaries describes that other panelists must sign-off on the final product and program officers and staff will also provide feedback (DEB Science Staff, 2015b). Therefore, the people serving on the panel can interpret the criteria in a different way than originally intended or disagree with others on the criteria, but the text provides the organization for what they have to respond to and others will act as the texts' agents in holding them accountable to it.

The reference text for the merit review criteria, and any action in NSF's core programmatic processes, is the Proposal & Award Policies & Procedures Guide (PAPPG). The text states, for example, that a proposal should be judged on its potential to "advance knowledge

and understanding within its own field or across different fields (Intellectual Merit)" (NSF, 2016b). The reference for what it means to advance knowledge is not explicitly laid out in NSF's texts, but calls on NSF's mission statement. NSF's mission, as defined by congress when it was established in 1950, is, "to promote the progress of science; to advance the national health, prosperity, and welfare; to secure the national defense; and for other purposes" (NSF, 2014). This is expanded in NSF's strategic plan to be accomplished through investing in fundamental science and engineering research. Smith (2005) argued that institutional texts are organized by regulatory frameworks that set the concepts and ideas by which the related texts are read. NSF's mission statement and supporting strategic plan texts set up two frames for reading the rest of the process through. The first is a "best science" discourse and the second is a "national interest" discourse.

Looking at the demographic statistics of NSF proposers, people might notice that NSF's target population of knowledge producers is wildly under-representative on almost every measure of diversity. Under the "best science" discourse, however, that same landscape gets read as NSF funding the best possible science by relying on leading experts in the field. The concept that comes along with the leading experts is the idea of an expert community helping define what the leading edge of research is through the merit review process. This idea repeatedly comes up in the NSF Director, France Córdova's testimony in congressional hearings and response to budget appropriations. In a hearing on the FY17 budget request, she said, "we very much value the opportunity to have science set the priorities for what we do. We think that's the healthiest way to ensure discoveries at the frontiers, have this input from the science communities" (Budget Hearing - National Science Foundation, 2016). This idea of the "community" giving input subsumes the particularities of the people actually involved in the process and the actuality of

those people being chosen through google searches of keywords. For example, according to NSF's FY14 Merit Review Report, "28.7% of panelists on in-person panels and 31.3% of panelists on virtual panels were women" (2015, p. 42). This is a slightly higher rate of representation than there is among research proposers (24.7%), but it highlights the issue with translating the advice of the male-dominated review population to "community input" that NSF then takes institutional action on without referring to the particularities of the group.

Similarly, the system of having institutions submit proposals on behalf of PIs, who then become managers of the project, relies on the existing inequality of ruling relations of the university system. This goes along with the idea of "promoting the progress of science" as an enterprise that makes the unequal relations of power involved in that enterprise invisible. The "best science" frame presents the entire knowledge producing endeavor as a competition on the basis of merit. This connects the process for funding research to the tenure system and ruling relations of Universities and capitalism that produce inequality, and normalizes the difficulty of the situation for many researchers to "succeed" that connect to on-going systemic discrimination. This operates as holding up a "fair" process at the point of deciding on proposals while ignoring the fundamentally unfair nature of everything leading up to that point. Even NSF's "Broadening Participation" initiative becomes couched in terms of being necessary because diversity produces better science. Thus, the focus is to "increase participation from underrepresented groups… in all NSF activities and programs" (NSF, n.d.). This doesn't change NSF's activities to include what different groups are doing in the name of producing knowledge or tackle the systemic inequality that makes it difficult to join in the existing effort, but seeks to bring people into the same system that perpetuates inequality.

The "national interest" discourse addresses the obvious flaw in the "best science" discourse: NSF only funds people affiliated with US-institutions. This tension is most ironically apparent in a blog post written by John Holdren, Director of the White House Office of Science and Technology Policy, and Subra Suresh, former NSF Director, where they discussed the importance of promoting high standards of merit review internationally (2012). After extoling the virtues of merit review they stated, "Why should Americans care if other nations commit to the principles of merit review? For one, U.S. researchers competing for global funds risk losing their fair share if other governments do not ensure merit-based review of U.S. proposals." That pushes the "best science" discourse onto other countries while not extending it to the way the US operates.

The "national interest" discourse is so convincing in regulating how the rest of the texts are read because it is the justification for the budget to Congress. At the start of NSF's FY 2016 budget request hearing, the chair of the appropriations subcommittee nominally responsible for determining NSF's budget, Rep. Culberson said, "We have a very difficult budget year, but we're going to continue to do everything we can to ensure you and the scientists that work under the peer review grant process that you oversee have the resources you need to maintain American leadership in scientific research" (Budget Hearing - National Science Foundation, 2016). He went on to make it clear that NSF was accountable to serving the "national interest" and he asked how NSF ensured all the research they fund was in that interest. NSF's director, France Córdova, responded by saying, "let me start with the establishing language for the National Science Foundation, which is our mission, and that is a mission by definition as we were established by congress to serve the national interest" (Budget Hearing - National Science Foundation, 2016). This mission is included at the beginning of most NSF policy documents, on the homepage of

the website, and featured prominently in every congressional hearing I reviewed and the processes that follow from it are held accountable to it by those given agency to do so in a variety of roles.

The frame of "best science" and "national interest" from NSF's mission sets up the relationships of the institutional texts to the actuality of what people are doing. From people produced, socialized, and sanctioned as leading minds by the education system in the US, to the inequality of the work involved for different people in preparing proposals, to the review of proposals on merit, the institutional texts serve to translate those experiences into categories that become actionable by the staff of NSF and DEB. The issue is that the categories that become actionable by DEB staff in deciding on proposals do not reflect the inequality that exists in that process, and thus ignore it and reproduce it.

Smith (2005) names the devices for translating the particularities of people's experiences into institutionally actionable categories "interrogatory." In DEB these are the solicitation requirements that spell out what DEB wants to know about a person's idea for knowledge production along the organizing of the "best science" and "national interest" frames. Then it goes to the individual review instructions, the panel summary instructions, and the review analysis instructions that all again serve to take the particularities of the people applying and the ideas they are putting forward into the frame of their value to science in the national interest. At every level, the institutional discourse constrains people from communicating their experience of the process to fit the concepts of merit that are of interest to the coordination of the process.

Once the proposal for a research project reaches the level of making a decision of whether to fund or not in DEB, it has been translated to fit the institutional discourse, evaluated on the categories given weight by that discourse, and certified as worthy of funding by that

coordination. At that point, DEB program officers take into account portfolio balance issues in

making final decisions on what to fund. At this point, program officers acting as the agents of the

textually mediated, institutional action can consider information in the categories designated by

government regulations as appropriate for collecting information about the particularities of a

proposer's identity. These categories are the regularly problematic ones of a small number of

racial categories, binary sex categories, federally recognized disabilities, and state of residence

that subsume the reality of differences that people might experience into institutionally

actionable ones. By relying on these categories at the stage of portfolio review, rather than

allowing proposers to communicate something about their identity or experience to be

considered, they continue to create, reinforce, and organize differences based on those

categories.

Ruling Relations

In thinking about how DEB can avoid reproducing, in their process, the inequality that

exists in the education system, economic relations, and social relations as a whole, it becomes

important to break or redefine the "best science" and "national interest" discourses that constrain

what can be done. To make the production of knowledge part of a more honest, collaborative,

and inclusive effort, it needs to work against the inequality present in the education and research

systems rather than reinforce it. The program descriptions of the various DEB programs list areas

of research they support, suggested topics, research approaches they encourage, and other

guidance. Those program descriptions are said to reflect the leading edges or priority areas for

the program, but they could easily include guidance on encouraging more engagement with

subjectivity in proposals or contain language about promoting applications with approaches not

traditionally supported. They could even require proposals to include plans to address systemic

inequality in the discipline. This would take a sustained effort from a lot of interested people. There is a strong organization to hold all levels of the process accountable to the discourse of "best science" and "national interest" as they have been put forth and operated in NSF. The agents of this accountability come from the community of researchers currently supported, university leadership, program officers, NSF staff, DEB leadership, Directorate leadership, NSF leadership, Congress, Office of Management and Budget (OMB) leadership, White House leadership, media, think tank, and corporate leaders. This organization of people holding NSF's institutional activities accountable to narrow conceptions of national interest and progress of science is apparent in congressional hearings on NSF.

The hearing on the FY17 NSF budget in the House Appropriations Commerce, Justice, Science, and Related Agencies Subcommittee demonstrates the connection to general struggles over representation in US politics. For example, climate denial efforts pushed by certain corporate leaders are apparent in the Chair, Rep. Culberson's statements, such as, "We don't want, for example, the climate change work that's being done to be driven by political agenda from either direction. We just want the facts. As Joe Friday said on Dragnet, we just want the facts so we can make, [pause] it's our job as policy makers to make good decisions based on accurate, objective, factual data" (2016). However, on the Democratic Party side, efforts to commercialize basic research for the benefit of other corporate leaders are apparent in the Ranking Member from Silicon Valley, Rep. Honda's statements when he defended NSF from efforts to defund climate change research and social science. He said, "the NSF is directly fueling our future innovative economy and is making sure that the next breakthrough technologies that lead to the next Silicon Valleys happen right here in the United States" (Budget Hearing - National Science Foundation, 2016). This shows that, through the state of our political

system, the interests of corporate leaders become the interests of the nation and connect back to

the research and education that happens at Universities and a larger effort to alter ruling relations

in the US. These kinds of exchanges offer one common defense for relying on community input,

merit review, and the discourse of scientific objectivity. It deters politicians from constraining

particular lines of inquiry and areas of research. However, to be "apolitical" in a context of

worsening inequality, oppression, and accumulation of power is not likely to improve the

situation.

Discussion

The strength of ruling relations present in the organization of DEB's work and the

connection to larger ruling relations demonstrates the need for a concerted and sustained effort to

re-design the processes that currently maintain, reproduce, or exacerbate inequality. Foucault

proposed that intellectuals have the power to break the problem of scholarship producing

inequality, but he said, "the problem is not changing people's consciousness - or what's in their

heads - but the political regime of the production of truth" (1980, p. 133). In the case of DEB the

regime of the production of truth that I have traced in this inquiry is very complex. An

institutional discourse built on narrow conceptions of "best science" and "national interest"

organize people's activities related to DEB through textually granted agency so that they propose

research, define programs, and decide on which research to fund in reference to conceptions that

support larger, unequal ruling relations. The interrogatories DEB uses to seek proposals from

researchers and advice from reviewers take particularities of the people involved or excluded

from the process and transform them into institutionally actionable concepts that hide inequality

and reinforce injustices in the education system. In order to overcome this, DEB leaders, staff,

researchers, and others involved will need to push to introduce new institutionally actionable

concepts based on the potential to undermine the power of ruling relations that create inequality.

Conclusion

In this inquiry, I discovered major power relations involved in producing knowledge in

the Division of Environmental Biology of the National Science Foundation. The theory and

literature on the relationship between knowledge and power in society describes a process of

power relations producing forms of knowledge and knowledge production serving to reinforce or

undermine those relations in a given time and place. Using an institutional ethnography approach

allowed me to identify that process as it happens through the textual coordination of activities

and translation of particularities of experience into institutionally actionable concepts. DEB's

activities toward funding researchers serve to reproduce and exacerbate inequality in this way by

conducting the majority of proposal review on "merit" without explicit consideration of the

inequality involved in the differences of people's experiences preparing proposals for

submission. I found this reproduction of inequality mediated strongly by the regulatory frames

constraining institutional discourse in DEB and NSF and in the strength of members of Congress

and the interests they represent to hold the people afforded agency by institutional texts in DEB

accountable to narrow frames of "best science" and "national interest." This suggests the need to

re-formulate the merit review process to include explicit consideration of the inequality that

shapes the disciplines of Environmental Biology in proposal review criteria and instructions.

Practical Applicability

People involved with DEB can use the map of how activities in the Division of

Environmental Biology are coordinated and the ruling relations involved that I discovered

through this inquiry to consider the impact of the current processes of DEB and work together

toward progressive change. One important way to do this would be to incorporate into DEB solicitations, program descriptions, and review instructions an emphasis on engaging with subjectivity in proposed research and on addressing systemic inequality in the discipline. This will begin to create institutionally actionable concepts around a new discourse oriented toward promoting the progress of doing science to challenge inequality and create social justice.

Recommendations for Future Inquiry

There are a vast collection of people that could be involved in producing knowledge about how our environment came to be and how it changes, and the particularities involved in each of their experiences makes taking the many standpoints involved challenging. However, for future inquiry it should be a priority to engage in dialogue with people who are interested in getting support for producing such knowledge through approaches that have not been traditionally supported by DEB. Additionally, the ruling relations involved in the trans-local coordinating of activities related to producing environmental biology knowledge is very complex. Future inquiry could seek to link the map of relations involved in DEB with a map of relations in a university department to make visible the larger coordinating discourses and power relations that organize our everyday lives trans-locally. In doing more institutional ethnography and pursuing the problematic of the coordination of our everyday lives, we will generate more in-depth and usable knowledge of the ruling relations that are involved and can be changed.

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Appendix A: DEB Panel Summary Template Sample
Source: *DEBrief* Blog (2015)

DEB Program
Full Proposal Advisory Panel

Don't delete any of the text from the template. This includes:
- the instructions in the brackets,
- the header, and
- the footer.

Be sure to:
- use complete sentences, screen for correct spelling and grammar, and
- make comments that are specific, evaluative, and well-justified

1.) RESULTS OF PRIOR NSF SUPPORT *[If applicable, please evaluate the accomplishments of the PI's past NSF-supported work.]*

Intellectual Merit: "N/A" or "The PIs have not made strong progress on their previous award; for example....." Or "The PIs have a recent award, but they do not discuss....."

Broader Impacts: "N/A" or "Valuable Broader Impacts came out of this work, including....." or "The PIs describe only the intellectual accomplishments, but....."

> Simply type "N/A" in both subheaders if the PI had no prior support. Otherwise, describe strengths and weaknesses or failure to report.

> A tidy, easy-to-read format leaves one space between subheaders and 2 or more spaces before the next section.

2.) REVIEW CRITERION I: INTELLECTUAL MERIT *[Please discuss the specific intellectual strengths and weaknesses and explain your evaluation.]*

Intellectual Strengths: The greatest strength of this proposal was its focus on an understudied aspect of the XYZ system, an important contributor to global LMNOP cycles. Previous attempts to study XYZ did not include ABC, but this proposal.....

Intellectual Weaknesses: The methods described in Experiment 3 would not achieve the PI's objective to study..... The reason is.....

> Get right to the point. Don't bother summarizing the proposal.

> Be specific and detailed in describing strengths and weaknesses.

> Tell the reader what specific aspects of the proposal made it strong or weak. Explain your evaluation.

3.) REVIEW CRITERION II: BROADER IMPACTS *[Please discuss the specific strengths and weaknesses of the broader impacts (including any postdoctoral mentoring plan) and explain your evaluation.]*

Broader Impact Strengths: The PIs plan to use this research as an opportunity to educate..... They thoroughly described their plan, including.....They have a good track record of working with the partner, for example.....

Broader Impact Weaknesses: The PIs should incorporate an assessment of the success of this activity.....

> Have the PIs chosen BI activities that are appropriate to the scope and capacities of the research and team? Explain why or why not.

> Don't focus on the number or novelty of the activities proposed. Rather, evaluate how well they will be carried out in this specific project.

4.) SOLICITATION SPECIFIC REQUIREMENTS *[If the proposal is a CAREER, OPUS, RCN, LTREB, or RUI, please evaluate the specific parts of the proposal that demonstrate how the PIs will or will not meet the solicitation specific criteria.]*

N/A is an option here if it's not one of these types of proposals

The PI has done an excellent job fitting this proposal to the requirements of the CAREER solicitation. Specifically, she plans to integrate the research and education components by….

> Demonstrate that the panel has carefully considered these requirements as part of their evaluation. Include specific details and explain what makes them strengths or weaknesses.

5.) DATA MANAGEMENT PLAN *[Please discuss the specific strengths and weaknesses of the data management plan and explain your evaluation.]*

Strengths:

The PIs have very clearly described their plan for data handling processes, including plans for dissemination and access through deposition of data to the online repository AAAAAA.

Weaknesses:

Preserving the spreadsheets in formalin is not a secure long term solution because the chemical…. Instead the PIs should seek out….

> Tell us whether the DMP was good or bad – but don't stop there! Tell us what specific things were strengths and weaknesses and why.

6.) SYNTHESIS AND RECOMMENDATION *[Please concisely summarize the main reasons for the panel's final recommendation.]*

Synthesis: This exciting research addresses a central problem in our understanding of LMNOP cycling. Other than Experiment 3, the methods in the proposal were sound and the proposed work would still be very successful in resolving the important question of XYZ. The Broader Impacts are generally strong and the PIs can easily incorporate the suggestions noted above.

The panel recommendation is: HIGH PRIORITY

> In 3-4 sentences, concisely explain the primary reasons for the final recommendation. Don't describe the proposal or copy what was said above.

> Will it be clear to someone who was not at the panel why the proposal was given this recommendation?

> Make sure the final recommendation is easy to see and matches what is up on the board!

This summary was read by the assigned panelists and they concurred that the summary accurately reflects the panel discussion.