Reimagining the broader impacts criterion in the NSF graduate research fellowship

Running Head: Reimagining the GRFP's Broader Impacts

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Abstract

For graduate students, securing prestigious fellowships provides incredible benefits such as increased job opportunities and likelihood of receiving awards. These benefits can be particularly life-changing for a graduate student who may come from a marginalized background. However, the inequity in fellowship distribution hinders the success of graduate students, especially those who are marginalized. The majority of the National Science Foundation's Graduate Research Fellowship Program (GRFP) is white and attend top-ranked institutions. Within the GRFP, there is a clear disconnect between the grantee's proposed broader impacts and follow-through. To value and support communities, and graduate students of color in the process, the GRFP must be reimagined. In this article, we provide a brief background on the relationship between STEM and marginalized communities, and how broader impacts currently function as a band-aid to the issues of justice, equity, diversity, and inclusion in STEM. We then conclude by providing recommendations to improve the broader impacts section and the awardee selection process.

Key Words: NSF GRFP, broader impacts, equity, justice, STEM, fellowships

Introduction

For prospective graduate students considering graduate school – especially those from marginalized backgrounds – access to funding is a substantial concern (Kennedy et al., 2016). These concerns can be alleviated by securing funding such as the National Science Foundation (NSF) Graduate Research Fellowship (GRFP). The GRFP financially supports awardees pursuing research-based graduate degrees within the United States by providing an annual stipend and cost-of-education allowance over three years, resulting in its highly competitive nature (www.nsfgrfp.org). The GRFP scores applicants on two main criteria: 1) intellectual merit: the proposal's potential on advancing knowledge in the applicant's field and 2) broader impacts: the proposal's potential to benefit society and contribute to the achievement of specific, desired societal outcomes. Evaluation of these two criteria ensures that the NSF supports high-quality research that advances our current understanding of the world and ultimately benefits society. However, the definition of "high-quality" is subjective and can create bias. For example, for National Institute of Health (NIH) funding, researchers found that Black scientists are 13% less likely to receive funding (Ginther et al., 2011) and less likely to receive funding due to topic choice (Hoppe et al., 2019). If reviewers are not as diverse as the applicant pool, they will fail to understand the barriers marginalized applicants navigate and the practical application for the work outside of basic science. In addition to the racialized bias that may occur, a reviewer's assessment of applicants may vary. Although NSF instructs reviewers to review based on the "merit review criteria and noting GRFP's emphasis on potential for significant research achievements", reviewers may strictly score applicants based on the proposed project and its impact on the applicant's field.

Applying for the GRFP can be incredibly beneficial for awardees and non-awardees alike. Participants reported feeling more confident in skills needed for success in graduate school such as developing testable hypotheses (Wiener & LeFevre, 2021). However, the chances of receiving this prestigious fellowship are not particularly high, with roughly 2,000 awardees selected from 13,000+ applications in 2020 (NSF GRFP, www.nsfgrfp.org). Moreover, the racial disparities in who is awarded the fellowship and an honorable mention is undeniable. From 1994 to 2011, 79.9% of awardees and 83.3% of honorable mentions were white (NSF, 2014). During this time, 7.9% of awardees were Hispanic, 10.3% were Asian, and 4.2% were Black (NSF, 2014). Within this, it's difficult to further understand the racial/ethnic disparities as 1) NSF does not report information on applicants, 2) the term "Hispanic" hides racial disparities by clumping in Indigenous, Black, and non-Black Hispanic individuals as one, and (3) terms like Asian and Black hide ethnic identity by creating racial monoliths (e.g., Nguyen et al., 2022) and Indigenous applicants are left out altogether. Lastly, we see similar gaps in representation in the educational background and institutions of current fellows, with 8.9% of awardees attending community college as an undergraduate and 94.5% of awardees and 94.1% of honorable mentions attending universities with very high research activity (R1 universities, e.g., University of California, Berkeley) (NSF, 2014).

Due to systemic barriers, Black, Indigenous, and People of Color (BIPOC) in STEM are highly underrepresented compared to their white counterparts (Garrison, 2013; Riegle-Crumb et al., 2019). In an effort to limit disparity, institutions distributing grants often require an outreach or broader impacts section. This encourages applicants to conduct outreach into marginalized communities to hopefully increase participation in, and diversification, of their respective fields. Bottom-up approaches like this have been used in academia to remedy inequities in the

representation and retention of systematically excluded groups in STEM (Ching et al., 2020). However, one of the issues with this bottom-up approach is the lack of top-down accountability and support in these ventures. The lack of accountability towards outreach for GRFP fellows may lead to detrimental effects such as the tokenization of marginalized communities at the hands of the academy (NSF, 2014). We argue that the current framework of the GRFP, specifically the broader impacts section, does not protect or help our most marginalized and underserved communities. Instead, it allows for further inequity and harm.

We do not claim the GRFP to be the sole solution to the many systemic issues in STEM. However, with the positionality that this program holds, this award can serve as a place to begin the conversation about (in)equity in academia. In this article, we will briefly give a snapshot of the history between STEM and marginalized communities, how broader impacts do not properly address the issues of diversity and inclusion in STEM, and how we see the future of the award, with recommendations for change.

Positionality statement

It is important for us to highlight and center our positionality for this article which is why we interrupted the article rather than end with it. Our positionalities have heavily influenced our decision to produce this work and shed light on this important issue. We all come from marginalized backgrounds with unique lived experiences and identities such as Black, Latin, Queer, first-generation, neurodivergent, and low-income. Because of these identities, we feel a need to address the broader impacts section as a larger issue of justice and equity. We have approached this work with our intersectional identities and recognize that other valuable perspectives may have been missed. We hope that by leveraging our experiences in white-

dominated academia we can shed light on inequitable funding and create attainable solutions that ultimately benefit individuals from marginalized backgrounds.

Biosciences and Marginalized Communities:

Colonialism is embedded in the science we practice (Trisos et al., 2021). The colonization of knowledge and its dissemination is maintained by centering white, cisgender, heterosexual male European scientists (Trisos et al., 2021). Many of these men have been deemed the "pioneers" in environmental and naturalist spaces (Finney, 2014), implying that nature and "correct" ecological knowledge is solely produced by them.

Disciplines like ecology have benefitted from the use of colonized land to establish research sites. This legacy can be seen, for example, by (a) the geographic distribution of bird species named after European men (Trisos et al., 2021) and (b) the location of field stations. Most field stations in Caribbean, Central America, and South America originated after a nation's independence from European colonialism under a brand of neocolonialism that scientists profited from (Ahmad-Gawel et al., 2021; Airhart, 2022). Field stations were typically formed in areas that had lasting colonial infrastructures such as plantations (Ahmad-Gawel et al., 2021; Airhart, 2022). Field stations that were founded on these grounds enable the practice of parachute science, where scientists from higher-income nations conduct research without engaging the community through collaborations like scientific partnerships, education programs, or the sharing of data (Ahmad-Gawel et al., 2021; Airhart, 2022; van Woesik et al., 2022).

The proposals of well-meaning broader impacts often contain ripples of colonization. The issue with proposing broader impacts statements that center on "vulnerable" communities is that these communities are viewed through a savior lens. These "damage-centered" proposals create a

fictitious image that these communities are broken and in need of help (Tuck, 2009), which may lead to the tokenism, the including of minority groups as a symbolic effort, of said community. Whether it is marginalized communities or principal investigators with marginalized identities who are being tokenized by academia, the scientific community can begin to correct this injustice by holistically investing in the success of marginalized groups (Miriti et al., 2020; Schell et al., 2020).

Disparities in representation and funding:

The way we propose broader impacts is a consequence of who is represented at the graduate and faculty levels. The NSF reports that 24% of baccalaureate and 13.6% of doctorate degrees in science and engineering are awarded to underrepresented minorities (NSF, 2019). We see similar gaps for faculty in biology, with only 25% of tenure-track and 15% of full professors being underrepresented minorities (Kozlowski et al., 2022). Among these numbers, Black (6%) and Indigenous (1%) faculty representation are especially low (Kozlowski et al., 2022). Socioeconomic status is a significant driver of the representation of academic faculty. Children of doctoral recipients that grow up in wealthy urban neighborhoods with parents in academia are 25x more likely to have full support in pursuing academic positions (Morgan et al., 2021). Socioeconomic status coupled with low racial diversity contributes to the lack of adequate representation in the academy (Stevens et al., 2021).

One of the reasons marginalized people are not well represented in academia is due to evaluation criteria for tenure (Corneille et al., 2019; Miriti et al., 2020; Schell et al., 2020). Publications and grants are valued over the impact of research on, or in collaboration with, local communities. Moreover, service is often overlooked by the academy (Corneille et al., 2019), with women of

color taking on a disproportionate amount of service (Corneille et al., 2019; Miriti et al., 2020; Schell et al., 2020).

Biases surrounding how and whose work is valued in the academy often work against talented BIPOC academics that balance producing publications and service work aimed at transforming the academia for BIPOC scholars (Corneille et al., 2019). For example, proposals, awards, and funding rates from the NSF report that white principal investigators (PIs) were awarded above the overall funding rate at 31.3% for all racial/ethnic groups while Asian and Black PIs were below the funding rate at 22.4%, and 26.5% respectively (Chen et al. 2022). We also see this in NIH-funded research, with white PIs funded at double the rate of Black PIs (Stevens et al., 2021). In addition to disparities in funding, systemic racism's existence and pervasiveness in academia is often denied, leading to the continuation of institutional practices that disproportionately harm Black and Indigenous scholars. Berhe et al.'s (2021) "hostile obstacle course" illuminates the constant levels of discrimination awaiting scholars of marginalized backgrounds as they reach for academic success. Academic isolation, bullying, and implicit biases in fellowships, awards, and peer review processes steadily contribute to this hostile obstacle course (Barber et al., 2020; Berhe et al., 2021; McGee & Bentley, 2017). If we are to make any substantial change, academia and funding institutions must prioritize investment in and support the advancement of marginalized scholars.

Empty Broader Impacts:

The "broader impacts" criterion was meant to replace two of the four previous NSF funding criteria, "utility" and "effect on infrastructure" (Davis & Laas, 2014; Rothenberg, 2010). 89% of proposals in the new system mentioned a broader impact on science, and 66% of proposals mentioned a broader impact on society (Roberts, 2009). Although broader impacts aims are

mandated as part of the application, the likelihood of achieving these impacts is not always taken into consideration. For example, between 2000 and 2010, of the 82 NSF proposals that focused on increasing involvement from marginalized communities, only 39 proposals, less than half, actually accomplished the work (Watts et al., 2015). These previous studies underscore how following through on broader impacts has generally not been a priority over time for NSF-funded proposals. Additionally, with a lack of data on broader impact completion for GRFP awardees, we see that there is less accountability with regards to the GRFP's broader impacts than other NSF grants. Overall, we argue that the broader impacts section does not properly address the needs of communities or hold accountability for awardees.

The disconnect between broader impact and community needs:

Similar to Hoppe et al's (2019) study, there is a mismatch between what white researchers think marginalized communities need in terms of outreach and what communities *actually* need. When writing the broader impacts section of the GRFP, individuals may be pushed to create "out the box" solutions to systemic issues, despite simple more community-focused solutions being necessary, leading to a clear separation in the broader impacts of the GRFP and the realized impacts on society/communities. This separation stems from a lack of understanding of community needs and the necessity for researchers to articulate broad impacts aims. When researchers write about supporting marginalized communities with no previous relationship to said community, they do nothing more than exploit them to receive grants and fellowships, in turn, creating the notion of academic commodification. This commodification manifests as researchers advance in their career while communities are left behind following the project's completion without having their needs heard or met. NSF's funding history creates a positive feedback loop where "successful" broader impacts statements stand on a non-existent foundation

that does not engage with the communities they aim to impact, does not fulfill its stated goals in any substantive way, and, instead, reproduces existing inequities.

Previous recommendations to bridge this separation include targeted training of outreach to marginalized communities, encouraging high-quality dissemination of research results to the public, and increasing diverse leadership within research projects (Intemann, 2009; Landry et al., 2001; Roberts, 2009). Targeted mentoring and training of marginalized communities were recommended using the social justice rationale conceptualized by Intemann (2009) to promote participation and interest while diversifying white-dominated STEM spaces. Dissemination of research or project results is key to gaining a sense of how successful broader impacts are. Proposed impacts should be readily available for public view, actively supported by the targeted community, and based on previous successful research (Roberts, 2009). In the next section, we suggest tangible pathways and recommendations to increase liability between proposed and realized broader impacts.

New Directions and Recommendations:

In order to move forward towards true justice, equity, diversity, and inclusion (JEDI), we must differentiate between “being involved” and “being heard.” Going forward, GRFP applicants must *involve* community leaders in their application and thoroughly *listen* to the community's needs. A more inclusive model for the GRFP application should be grounded in this form of inclusivity and horizontal leadership style between applicant and community leader. Moreover, transparency and accountability are needed for progress to occur. To this degree, we bring forward five recommendations, categorized into assessments, implementation, and broadcasting, that the NSF could incorporate to make the first steps towards solving the identified issues.

Assessments

(1) Diversify Reviewers

Diversity leads to a stronger and more robust field of science (AlShebli et al., 2018; Campbell et al., 2013; Plaut, 2010). However, this has not scaled up to the review process. What is considered important in terms of research and impact is left open to reviewers and this has led to inequities in funding success, particularly for Black scientists (Hoppe et al., 2019). We reemphasize that reviewers of the GRFP must be diverse in terms of, but not limited to, race, ethnicity, gender, sexuality, class, neurodivergence, and physical ability in combination with appointment (e.g., government researchers, non-profits) and home-institution (e.g., HBCU, predominately undergraduate institution). Diversity in appointment type is needed to ensure that reviewers have experience in applied broader impacts projects to review the proposed broader impact's feasibility and likelihood for success.

(2) Correcting Reviewer Bias

The assumption that tenure-track and tenured faculty members can effectively and holistically evaluate applicants, both on intellectual merit *and* broader impacts, is a blind spot created by the nature of academia. Although reviewers are able to critically evaluate research due to their expertise in their respective fields, not all reviewers are equally equipped to evaluate the impact of broader impacts due to the lack of emphasis and value tenure evaluation places on outreach. Moreover, it is unrealistic to assume that reviewers, who may encompass privileged identities, will not allow any bias in their reviews. Thus, we emphasize that NSF should revamp their current anti-racist training for all reviewers by, for example, explicitly denouncing colorblind racial ideology, which can be positively associated with anti-Black prejudice and negatively

associated with anti-racism (Yi et al., 2022), and creating an equity-based scoring rubrics to inhibit biases within reviewing. Lastly, to prevent bias that may occur even with these preventive measures, all reviews should be given feedback by other colleagues to (1) catch wrongful scoring due to potential bias and (2) prevent harmful reviews from reaching applicants. Preventing harmful reviews that may contain microaggressions from reaching applicants, particularly those who come from a marginalized background, is crucial as this can influence an individual's mental health (Anderson, 2017; Auguste et al., 2021), productivity (Steele, 1997; Torres et al., 2010), and more generally, their sense of belonging (Lewis et al., 2021). Individuals that do catch harmful reviews should inform NSF officials of said review so (a) NSF officials can inform the reviewer of the harmful language used and (b) potentially remove the reviewer from further being involved in the review process depending on the rhetoric used and history of issues with said reviewer.

Implementation

(3) Community Partnership

Many applicants propose broader impacts with a specific community in mind. However, very little applicants have discussed these plans with actual community leaders or organizations doing similar work and thus, have any community support for the proposed broader impacts. We *strongly* encourage all applicants of the GRFP, especially current graduate students, to contact and have an open conversation with organizations and community leaders when crafting broader impacts. We believe that proposing community-centered broader impacts with no intent of completing them and without listening to the community contributes to the larger white-supremacy culture of academia and taking this step is one way to combat the culture. An active

conversation with community leaders is important for identifying the needs of a community and where the proposed work fits in the ongoing efforts in the community, which will in turn create stronger plans with substantial communal impact.

(4) NSF Supplemental Funding and Letter of Support

Individuals who propose high-quality broader impacts for their GRFP application immediately encounter obstacles in the form of funding. We call on NSF to allocate funds for GRFP fellows to implement their proposed broader impacts, as this will likely significantly increase follow through. This is important as awardees, especially those from marginalized backgrounds with experiences that would create strong service plans, may lack appropriate support and infrastructure to accomplish their proposed broader impacts. If implemented, NSF should require awardees to submit a letter of support from a community leader or organization supporting their work to access this supplemental funding. This letter should address what the applicant has proposed in their application and detail the letter writer's enthusiasm for the proposed activities, confirm an established relationship, and discuss how the proposed broader impacts section dovetails with or expands on the work currently being done. This will ensure that all stakeholders, including the community, are aware and agree with the proposed broader impacts.

Broadcasting

(5) Publicization of Successful Broader Impacts

Transparency is crucial for moving any field forward to understand what works, what does not, and where there is room to expand. With this in mind, we expand on Roberts (2009) suggestion to strictly require, not encourage, all awardees of the GRFP to publicize their proposed broader

impacts and broadcast their actualized broader impacts on an appropriate medium. These mediums could include open-access journal articles, personal websites, and video platforms such as YouTube. These efforts could promote credibility between researchers and community leaders/members along with providing templates for related community service activities. Lastly, NSF should request survey completion from community leaders that detail proposal completion and realized community impact.

Conclusion

To critically reform our institutions, we must reevaluate the traditions we perpetuate. Many traditions – such as tenure evaluation and graduate student stipends – have dramatic consequences on diversity and inclusion (Marin-Spiotta et al., 2020; Schell et al., 2020) as well as student mental health (Assembly, 2014; Barreira et al., 2018; Coffino et al., 2021; Evans et al., 2018; Mackie & Bates, 2019). Unsurprisingly, these norms disproportionately harm individuals from marginalized backgrounds (Grogan, 2019; Silbiger & Stubler, 2019; Smith et al., 2007).

The academy has a long way to go before the "hostile obstacle course" is dismantled. This paper contributes to the growing body of literature on routes of reformation by tackling a place where graduate students, especially those from marginalized backgrounds, experience inequity, and discrimination. As graduate students of color who encompass intersecting marginalized identities and that have (applied for) the GRFP, we feel the pain that our colleagues face regarding fellowship inequity and financial hardship. We believe that the broader impacts criterion in the GRFP can be one way to begin repairing the polluted relationship between institutions and marginalized communities but only if these activities are done right and with full engagement and participation by the communities in question. For this reason, we clarify that we are not

proposing an outreach plan be required in the GRFP as this would result in disingenuous broader impacts. Instead, we are stating that applicants who choose to propose broader impacts for a specific community actually *involve* the community through partnership in project creation and completion. Overall, the recommendations put forward in this article are meant to serve as one pillar in a plethora of solutions to move academia forward in academic JEDI work and outreach into marginalized communities.

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