WIP: NSF-funded Activity in Support of the LGBTQ+ Community: Award Search Strategy and Selection Criteria

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1. Introduction

The National Science Foundation (NSF) competitively awards funding to fuel the United States science and engineering enterprise. These awards may be utilized to study marginalized communities, typically motivated by a broader goal to increase engagement in science, technology, engineering, and math (STEM). Recent studies have made significant advances in unveiling LGBTQ+ inequities and marginalization in STEM, such as disparate retention rates in STEM educational programs [1] and professional devaluation [2]. These emerging studies suggest that the LGBTQ+ community is marginalized and that the LGBTQ+ community should be included in efforts to broaden participation in STEM.

Suitably, the number of grants awarded to study and support the lesbian, gay, bisexual, transgender, and queer (LGBTQ+) community in STEM fields has grown over the past few decades. For example, in 2020, the NSF awarded the first-ever CAREER grant that explicitly included the acronym "LGBTQ" in the proposal title (Award No. 2046233). In other cases, the LGBTQ+ community is not the direct focus of the proposed research, yet the community may still benefit from efforts within the grant that falls under the NSF's "broadening participation" theme. For example, another CAREER grant primarily studies nonlinear mechanics of soft materials but also aims to establish LGBTQ+ mentorship networks (Award No. 2145512).

In this Work in Progress (WIP) paper, we detail the initial steps taken to study NSF grants that seek to benefit the LGBTQ+ community through understanding their experiences or by working toward their full participation in society. To this end, we have identified active and expired NSF grants that either advance knowledge of LGBTQ+ experiences or offer some benefit to the community (e.g., tailored professional development, addressing and changing the marginalizing culture of STEM, etc.). We then developed a coding scheme to categorize these grants with respect to the level of positive impact they have on the LGBTQ+ community using modified Intellectual Merit (IM) and Broader Impacts (BI) criteria that parallels the NSF's own criteria for evaluating proposals. The work established in this paper to identify and code LGBTQ-focused NSF grants will next allow us to extract trends in these grants over a period of over 4 decades.

2. Methods

2.1 Creating the Award Dataset

We followed a multi-step process to create the award dataset. First, we developed a list of keywords to search within the NSF's award database that would best capture awards that benefit the LGBTQ+

community. The keyword list includes thirty-five terms, ranging from single-word terms to multi-word terms, to acronyms (see Table 1). While the keyword list is not exhaustive, it provides comprehensive coverage to search for the types of awards of interest to this study.

Table 1. Keyword list for award collection (acronyms' definitions are included for illustration purposes).

Agender	Genderqueer	Queer
Asexual	Gender spectrum	QUILTBAG[1]
Assigned sex	Homosexual	Romantic identity
Bisexual	Intersex	Sexual and gender minority
Gay	Lesbian	Sexual minority
Gender and sexual minority	LGB	Sexual orientation
Gender nonconforming	LGBT	SOGI[2]
Gender dysphoria	LGBTQ	Third gender
Gender expression	LGBTQ+	Transsexual
Gender fluid	Misgender	Transgender
Gender identity	Nonbinary	Two-spirit
Gender neutral	Pansexual	

[1] Queer, Questioning, Undecided, Intersex, Lesbian, Trans, Two-Spirit, Bisexual, Asexual, Allied, Gay, and/or Gender Queer. [2] Sexual orientation and gender identity

Next, we used the Awards Advanced Search tool available on NSF's website to find instances where the aforementioned keywords appear in the title or abstract of NSF awards. We conducted the search in late January 2023, including both active and expired awards, with a cutoff start date of December 31, 2022. The NSF search tool indicates that "data prior to 1976 may be less complete" (NSF, 2023); thus, our dataset can be considered representative of the period from 1976 to 2022. Finally, we merged and consolidated the lists generated from each term search to generate a preliminary dataset. The consolidation process involved removing (a) duplicates (the same award number reappearing in new term searches); (b) transfer grants (a "replacement" grant with a different award number due to the PI changing institutions); and (c) collaborative awards with multiple instances (awards with same title and

abstract beyond the first instance; in those cases, information about collaborating investigators, institutions, and budgets was preserved for subsequent analyses).

2.2 Developing the Coding Scheme

Our process to develop a coding scheme was iterative, guided by an evolving goal: to create a set of categories that would differentiate the centrality of LGBTQ+ populations and their experiences as the focus of the awards. The process began by analyzing a group of active awards to understand the diverse nature of the projects. Then, the lead author selected a subset of fifteen awards that demonstrated a range of LGBTQ+ centrality in the focus of the projects. For example, some studies purely focused on studying LGBTQ+ populations and their experiences, while others mentioned LGBTQ+ support as a tangential feature of the proposal. We used this subset to work through three major iterations of the coding scheme, each involving a series of refinements.

In the first iteration, we identified a single dimension with seven categories, ranging from (1) the research topic is exclusive to the LGBTQ+ community, to (7) the grant does not concern the LGBTQ+ community in any way. As we refined the codes in this stage, two salient characteristics emerged: (a) whether the core research topic of the award focused on the LGBTQ+ community (either exclusively or as one of at least two marginalized groups), and (b) the degree to which the outreach activities intentionally and thoughtfully centered the LGBTQ+ community.

As we began conceptualizing the second iteration, we operationalized the two aforementioned characteristics as dimensions with three levels each (low, medium, and high; see Figure 1). This approach resolved some of the earlier discrepancies in the codes each author had assigned to every award in the subset; however, ambiguity remained in a couple of instances. After thorough discussion about the coding discrepancies, the authors agreed that a more precise way to operationalize the two dimensions would be to utilize the NSF's own review criteria as modified versions of IM and BI.

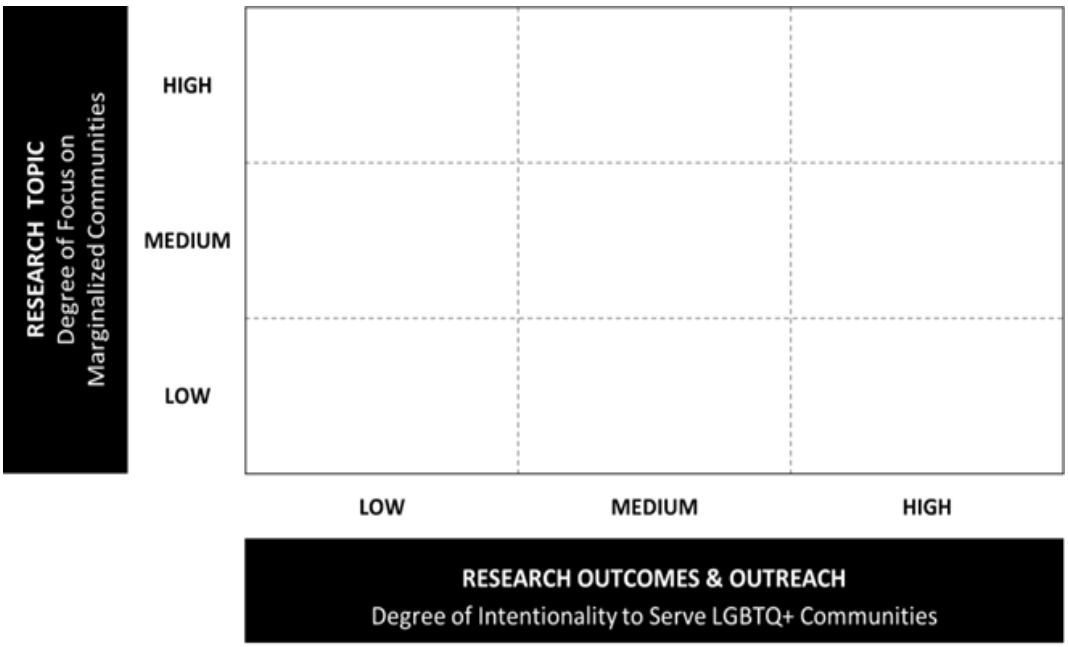

Figure 1. Two-dimensional representation of the coding scheme (second iteration).

Thus, the third iteration of the coding scheme used the following operational definitions for the two key dimensions:

- **Intellectual Merit**: Potential to advance knowledge about the experiences of and issues faced by LGBTQ+ populations.
- **Broader Impacts**: Potential to improve the well-being of LGBTQ+ populations.

Each dimension was divided into four levels or categories (none: 0, low: 1, medium: 2, and high: 3), as described in the results section (see Tables 3 and 4).

3. Results

3.1 The Award Dataset

Table 2 summarizes the query results using the advanced search function on the NSF website. The terms "gay," "sexual orientation," and "LGBTQ" yielded the highest number of results relevant to the focus of our study, with 59, 51, and 50 results, respectively. The term "asexual" yielded 251 results, a significant departure from the average for other search terms (~20). A closer examination of the first ten award titles revealed an unequivocal contextual explanation–the meaning of "asexual" was more closely associated with the field of biology (e.g., asexual reproduction in different organisms). Additionally, we briefly reviewed each grant abstract associated with the search term and found no cases that pertained to human sexuality as relevant to this study. As such, we excluded "asexual" from the search results. We

also excluded the term “LGBTQ+” from the results because the NSF Award Search does not allow for the use of special characters (in this case, “+”).

Table 2. Number of awards found per key term.

Keywords	Active Awards	Expired Awards	Total
Agender	0	1	1
Assigned sex	0	26	26
Bisexual	3	1	4
Gay	5	54	59
Gender and sexual minority	2	0	2
Gender nonconforming	2	0	2
Gender dysphoria	0	1	1
Gender expression	0	4	4
Gender fluid	0	0	0
Gender identity	17	27	44
Gender neutral	3	24	27
Genderqueer	0	0	0
Gender spectrum	0	0	0
Homosexual	0	18	18
Intersex	1	0	1
Lesbian	1	21	22

Table 2 (continued)

Keywords	Active Awards	Expired Awards	Total
LGB	0	2	2
LGBT	3	6	9
LGBTQ	32	18	50
Misgender	1	0	1
Nonbinary	3	11	14
Pansexual	0	0	0
Queer	1	5	6
QUILTBAG	0	0	0
Romantic identity	0	0	0
Sexual and gender minority	0	1	1
Sexual minority	0	5	5
Sexual orientation	24	27	51
SOGI	0	0	0
Third gender	0	1	1
Transsexual	0	0	0
Transgender	6	10	16
Two-Spirit	1	0	1

After consolidating the award lists for each term (removing duplicates, e.g., transfer awards, and collaborative awards with multiple instances), the preliminary dataset included 285 awards (90 active and 195 expired). We anticipate that the next phase of the analysis will further reduce the number of awards in the final dataset by eliminating the awards deemed irrelevant to the scope of this paper (i.e., those rated as “0” in both the IM and BI dimensions).

3.2 The Coding Scheme

Tables 3 and 4 provide operational definitions for each of the four levels across the IM and BI dimensions, respectively. These tables also provide excerpts from award abstracts that illustrate each of the levels.

Table 3. Operational definitions for levels across IM.

Level	Definition	Representative sample text from award abstracts
0	Focus on advancing knowledge of LGBTQ+ experiences and issues is nonexistent.	"Microbiota of each lizard complex (parthenogen + bisexual parent(s)), will be examined within a single vegetation community..."
1	Focus on advancing knowledge of LGBTQ+ experiences and issues is peripheral to the project.	“Online abuse and harassment are rampant on existing social networks sites, and is [*sic*] especially severe for women, people of color, and the LGBTQ community. However, technical and design approaches that could curb such abuse cannot be realistically implemented in advertisement-based business models, as such anti-abuse approaches often limit advertisement impressions. The new social platform has innovative anti-abuse technologies and a novel business model with no advertisements.”
2	Focus on advancing knowledge of LGBTQ+ experiences and issues is a substantial facet of the project but is not the essence of the project.	“This project will continue the Collaborative Multiracial Post-Election Survey (CMPS). The 2020 CMPS will include an estimated total of 20,000 completed interviews among Asian (n=4,000), African American (n=4,000), Latino/a (n=4,000), White (n=2,000), Native American (n=1,000), Native Hawaiian (n=1,000), Black immigrant (n=1,000), Afro-Caribbean (n=1,000) as well as a sample of Muslim respondents (n=1,000) and LGBTQ (n=1,000).”
3	Focus on advancing knowledge of LGBTQ+ experiences and issues is the essence of the project.	"The project will develop and research a model for engaging LGBTQ+ youth experiencing housing insecurity in an engineering education program."

Table 4. Operational definitions for levels across BI

Level	Definition	Representative sample text from award abstracts
0	Focus on improving the well-being of LGBTQ+ populations is nonexistent	"This project has an important impact on broadening participation of Latinx students in engineering, as results will inform engineering educators and help justify efforts on creating a more inclusive and supportive campus climate for all learners." (Note: no mention of how the project is designed to include or beneficially impact the LGBTQ+ community is included in this abstract description, hence this grant is coded as a 0 for BI).
1	Focus on improving the well-being of LGBTQ+ populations is peripheral	"The principal investigator will assign Wikipedia editing in engineering classes and host Wikipedia edit-a-thons for the scientific community, both improving the students' scientific writing and communication abilities, as well as Wikipedia's technical content and the representation of Black, Latine, women, LGBTQ+, and other underrepresented scientists."
2	Focus on improving the well-being of LGBTQ+ populations is a substantial facet of the project, but is not the essence of the project	"The research plan is integrated with the education and outreach plan which includes: 1) recruitment, training, and mentoring of undergraduate and graduate students from diverse backgrounds including women, URM, and LGBTQ groups through in-depth research experiences..."
3	Focus on improving the well-being of LGBTQ+ populations is the essence of the project	"These analyses will shed new light on the ways in which cultural, social, political, and legal factors affect both the prominence of legal concepts in a marginalized community and the character of the legal consciousness of [the LGBTQ+] community, including attitudes toward legal and political actors."

The three authors independently coded the initial subset of fifteen awards and selected the interclass correlation coefficient (using single rater, absolute agreement, two-way random effects model) to assess interrater reliability, according to the guidelines provided by Koo and Li [3]. The intraclass correlation coefficients were 0.98 (excellent reliability) and 0.89 (good reliability) for IM and BI, respectively.

4. Discussion & Outlook

NSF proposal reviewers apply IM and BI criteria to rank grants and recommend priority for funding. The evaluation process can take a significant emotional toll on researchers, as review comments carry judgment about the value and worth of novel research ideas. The authors of this study emphasize that the application of our modified IM and BI criteria in this study exists only to identify grants with LGBTQ+

aspects and to categorize grants with similar LGBTQ-related priorities. The IM/BI numerical score is not meant to impart criticism about the grant, its worth, or how the PI chose to incorporate efforts to support and/or study the LGBTQ+ community. The operational definitions of IM and BI for this study allow us to categorize the level of benefit to the LGBTQ+ community for each grant in our overall dataset. For example, a grant with an IM/BI score of 3/3 suggests research aims and project outcomes that are highly focused on advancing knowledge and improving the well-being of the LGBTQ+ community.

Although our preliminary results demonstrate success in identifying and categorizing NSF awards with LGBTQ+ aspects using publicly available data, there exist limitations to the methodology and its application. The NSF first established IM and BI as review criteria in 1997, replacing its prior criteria that had asked reviewers to evaluate proposals with respect to researcher competence, intrinsic research merit, research utility, and the effects of the proposed research on science and engineering infrastructure [4, 5]. Thus, our coding scheme of modified IM and BI themes may not best capture the LGBTQ+ nuances of NSF awards prior to 1997 in our database since these abstracts had not been written to demonstrate these themes. Despite this limitation, our methodology still serves the purpose of identifying and categorizing NSF grants that seek to study or support the LGBTQ+ community.

In our future work, we will proceed to code all 285 grant abstracts. This research framework will allow us to assess how LGBTQ+-aligned NSF grants have developed over the past few decades and roughly estimate growth in this activity in terms of funds awarded and number of participating investigators. We further intend to disaggregate the data by award type, program, and directorate, as well as by area to identify which STEM fields have experienced the most significant growth in LGBTQ+-aligned research and outreach activity.

5. Acknowledgement

This material is based upon work supported by the National Science Foundation under Grant No. 1748499.

6. Disclosure

S.F. acknowledges compensation from the American Society for Engineering Education for her role as PI on the above grant.

7. References

[1] B. E. Hughes, "Coming out in STEM: Factors affecting retention of sexual minority STEM students," *Science Advances,* vol. 4, no. 3, p. eaao6373, Mar 2018, doi: 10.1126/sciadv.aao6373.

[2] E. A. Cech and T. J. Waidzunas, "Systemic inequalities for LGBTQ professionals in STEM," *Science Advances,* vol. 7, no. 3, p. eabe0933, Jan 2021, doi: 10.1126/sciadv.abe0933.
[3] T. K. Koo and M. Y. Li, "A guideline of selecting and reporting intraclass correlation coefficients for reliability research," *Journal of Chiropractic Medicine,* vol. 15, no. 2, pp. 155-163, 2016.
[4] National Science Foundation. "NSF to Adopt New Merit Review Criteria." https://www.nsf.gov/news/news_summ.jsp?cntn_id=102789 (accessed April 14, 2023).
[5] National Science Board and National Science Foundation Staff Task Force on Merit Review (1997). *NSB/MR-97-05, Final Recommendations*. [Online] Available: https://www.nsf.gov/pubs/1997/nsbmr975/nsbmr975.htm