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A Push for Inclusive Data Collection in STEM Organizations

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Abstract: Professional organizations in STEM (science, technology, engineering, and mathematics) can use demographic data to quantify recruitment and retention (R&R) of underrepresented groups within their memberships. However, variation in the types of demographic data collected can influence the targeting and perceived impacts of R&R efforts - e.g., giving false signals of R&R for some groups. We obtained demographic surveys from 73 U.S.-affiliated STEM organizations, collectively representing 712,000 members and conference-attendees. We found large differences in the demographic categories surveyed (e.g., disability status, sexual orientation) and the available response options. These discrepancies indicate a lack of consensus regarding the demographic groups that should be recognized and, for groups that are omitted from surveys, an inability of organizations to prioritize and evaluate R&R initiatives. Aligning inclusive demographic surveys across organizations can provide baseline data that can be used to target and evaluate R&R initiatives to better serve underrepresented groups throughout STEM.

One-Sentence Summary: Inclusive demographic data collection can equip professional organizations to better serve underrepresented groups in STEM.

Main text: Professional organizations in STEM are uniquely positioned to improve the recruitment and retention (R&R) of underrepresented groups (*1*, *2*) by providing targeted professional development, networking opportunities, community support, and political advocacy (*3*, *4*). Tailoring an organization's initiatives to specific underrepresented groups can enhance their impact (*5*), but this is predicated on organizations knowing their demographic make-up (*6*). Baseline demographic data, when compared to the general population (across STEM or the U.S.), can help organizations set and prioritize R&R goals and, when monitored over time, help organizations evaluate the effectiveness of R&R efforts. Federal agencies often provide the most relevant demographic data for the general population in STEM (National Science Foundation) and the U.S. (U.S. Census Bureau) because of their surveys' large sample sizes and broad distributions. As a result, organizations may be compelled to use federal surveys as a model for demographic survey design and for benchmarking (i.e., comparing their organization's demographic diversity to the general population). While these agencies survey many categories of demographic information (e.g., gender identity, family status, citizenship, abilities, race and ethnicity), they do not collect all the demographic information that is considered meaningful to describe the STEM community in the U.S. - i.e., treating some groups as homogeneous (*7*) and ignoring other groups completely (*8*). In contrast, *inclusive* demographic surveys acknowledge the full diversity of identities that are meaningful to members of the STEM community. Thus, organizations seeking to describe their demographic composition are pressured to choose between following the examples of federal agencies versus creating new, inclusive surveys to recognize additional (and evolving) identities within the STEM community.

Here, we report patterns in demographic data collection and usage by STEM organizations, based on information obtained from 73 U.S.-affiliated professional societies. While these organizations can have international memberships of up to 40% (*6*), we focus our study on the demographic data that are culturally important in the U.S., under the assumption that U.S.-affiliated organizations usually hold events in the U.S. and thus the relevant demographic context is U.S.-based. In finding short-comings of the demographic surveys used by most societies, we sought to identify national survey programs that can serve as models for inclusive survey designs by STEM organizations and, where possible, to provide demographic information for benchmarking relative to the general population. We conclude by advocating that organizations leverage high-quality and inclusive demographic data, collected through improved surveys, to prioritize and evaluate R&R efforts. In particular, we propose that aligning demographic surveys across organizations can facilitate the sharing of effective R&R strategies and lead to widespread improvements in the support for underrepresented groups in STEM.

A survey of surveys

We surveyed 164 STEM organizations (73 responses, rate = 44.5%) between December 2020 and July 2021 with the goal of understanding what demographic data each organization collects from its constituents (i.e., members and conference-attendees) and how the data are used. See Supplementary Material for more details on the questionnaire. Organizations were sourced from a list of professional societies affiliated with the American Association for the Advancement of Science, AAAS, (n = 156) or from social media (n = 8). The survey was sent to the elected leadership and management firms for each organization, and follow-up reminders were sent after one month. The responding organizations represented a wide range of fields: 31 life science organizations (157,000 constituents), 5 mathematics organizations (93,000 constituents), 16 physical science organizations (207,000 constituents), 7 technology organizations (124,000 constituents), and 14 multi-disciplinary organizations spanning multiple branches of STEM (131,000 constituents). A list of the responding organizations is available in the Supplementary Materials. Based on the AAAS-affiliated recruitment of the organizations and the similar distribution of constituencies across STEM fields, we conclude that the responding organizations are a representative cross-section of the most prominent STEM organizations in the U.S. Each organization was asked about the demographic information they collect from their constituents, the response rates to their surveys, and how the data were used.

Most STEM organizations (80.8%) collect demographic information from their constituents. Commonly surveyed demographic categories included sexual orientation, disability status, racial and ethnic identity, and gender identity (Figure, left). The number of options offered for each demographic category varied among organizations, resulting in datasets with different resolution and validity. Unique response options for each demographic category are provided in the Supplementary Material. Of the organizations that provided response rates to their surveys (n = 22), the average response rate was 36.1% (s.d. = 30.4%), which is close to response rates reported by other organizations (*9*). When asked the year of their most recent demographics survey, 29 out of 59 organizations (49.2%) indicated either 2020 or 2021, 7 (11.9%) indicated a year from 2012-2019, and 15 (25.4%) indicated that they collect demographic information on a rolling basis with member registration. Of the organizations that collected demographic data, 87.5% reported using demographic data for one or more purposes that fell in the general categories of temporal monitoring, resource planning (e.g., for conferences), publishing reports (e.g., internal or external reports summarizing organizational growth), writing grant proposals, and contributing to third-party research (Figure, right). Some respondents provided specific examples which included using data to create statistical reports for an organization's Board of Directors, writing proposals and progress reports to federal funding agencies, and ensuring diverse representation on organizational service committees and speaking panels. Thus, there are disparities between STEM organizations in the underlying design of demographics questions, the administration of surveys, and the usage of the collected data.

Our results indicate that some STEM organizations do not seek to recognize entire groups in STEM, including individuals in sexual minorities (i.e., LGBTQ+ people) or individuals with disabilities (Figure, left). This observation is surprising given the well-documented discrimination and underrepresentation of these groups in STEM (*8*, *10*). Furthermore, variation in response options on demographic questions, e.g., for racial and ethnic identity and gender identity, signals that only a fraction of organizations aim to give a voice to unique identities that are frequently relegated to broader demographic classifications. For instance, numerous Asian American and Pacific Islander (AAPI) ethnic groups are often consolidated into a single "Asian" or "AAPI" grouping (*7*). In response to survey designs that ignore or obfuscate demographic identities, individuals from underrepresented groups may elect not to respond to certain questions or elect not to complete the survey, introducing a nonresponse bias into the data. Nonresponse biases may become even more significant if surveys lack anonymity - e.g., data collected during member registration are likely linked to a respondent's identity (*11*, *12*). Cumulatively, these findings suggest that the bulk of professional organizations in STEM are not collecting demographic data that are representative of the true diversity within STEM, which misinforms any subsequent use of the data for supporting or guiding organizational operations such as R&R.

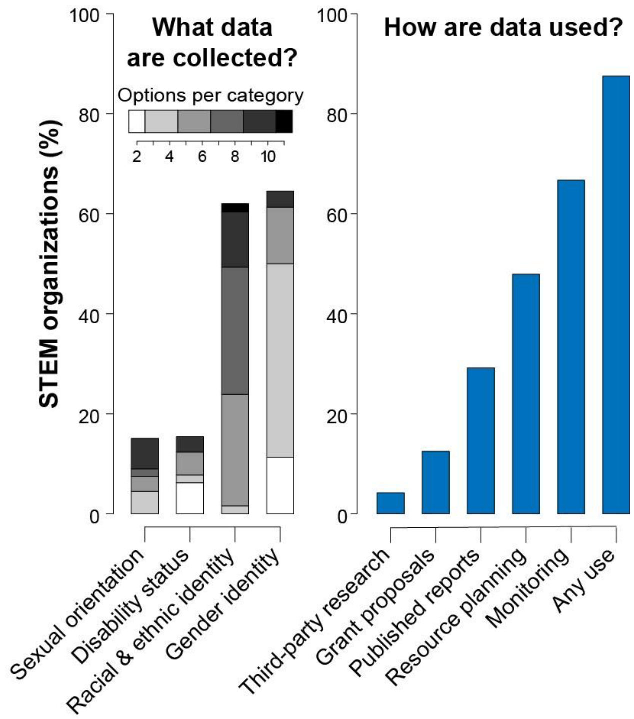

Figure 1. Demographic data collection and usage in STEM organizations. We obtained information about demographic data collection and usage from 73 STEM organizations, representing 712,000 members and conference-attendees. (Left) Organizations most commonly collected race, ethnicity, and gender identity information, but with different resolution and validity. (Right) Demographic data were commonly used for monitoring and resource planning. 'Any use' refers to one or more of the individually listed uses.

Guides for survey design

Importantly, our data and the recommendations made here are based on a subsample of U.S.-affiliated STEM organizations and thus they are limited in part by the demographic categories that are prominent and culturally important in the U.S. Nonetheless, we believe the principles outlined below are applicable to both U.S. and international organizations. STEM organizations can look to national surveying programs with publicly available data to model demographics survey designs and provide benchmarking of organizational diversity relative to the general population (*13*), though these national programs may have flaws. In the U.S., three such programs are the National Science Foundation's Survey of Earned Doctorates (SED), the U.S. Census Bureau's American Community Survey (ACS), and the Center for Disease Control and Prevention's National Health Interview Survey (NHIS). The SED targets individuals receiving research doctorates in the U.S. (~55,000 per year), while the ACS targets the general U.S. population (~3.5 million households per year). Thus, the SED and ACS can provide relevant benchmarking data for demographics surveys of STEM organizations, but the diversity of identities recognized in their survey questions pale in comparison to the questions of the smaller NHIS (~32,000 to 59,000 households per year, 2015-2020). For example, in questions on race, the NHIS and ACS each recognize seven unique Asian identities whereas the SED recognizes only a singular Asian group. For ethnicity, the NHIS recognizes seven unique Hispanic or Latinx identities, whereas the ACS and SED each recognize only four. Organizations wishing to describe international constituents should avoid describing racial groups as "American" (e.g., "Asian American") and consider asking for country of residence (*6*). However, "residence" can have several definitions, such as legal versus historical, so surveys should be explicit in their use of this term.

In addition to race and ethnicity, the NHIS asks sexual orientation (SED and ACS do not explicitly do this), and the survey includes a series of questions regarding cognitive, motor, visual, and auditory abilities that are more comprehensive in scope and response options than the abilities-related questions of the SED or ACS. Thus, for racial and ethnic identity, sexual orientation, and disability status, the NHIS is likely the most effective, all-in-one guide for question design and benchmarking by STEM organizations. Unfortunately, the SED, ACS, and NHIS do not ask questions explicitly related to gender or transgender identity. Programs that survey these categories do not, to our knowledge, publicly release data that would be helpful for benchmarking by STEM organizations, but their survey questions can still act as guides. For instance, Indiana University's National Survey of Student Engagement provides a model for gender identity questions (with additional, non-binary response options), and a survey from the advocacy group, National Center for Transgender Equality, provides a model for transgender identity questions. Outside of the U.S., organizations can follow these same guidelines by identifying large-scale, local survey programs that collect and report meaningful data from the general population and modifying the survey as needed to provide inclusive questions and options.

STEM organizations may wish to survey demographic categories beyond those discussed here, which were limited to the four most surveyed categories observed in our dataset (Figure, left). We encourage organization leaders to find inclusive guides and benchmarking data for additional categories using reputable sources, such as the national survey programs described above. And just as national surveys evolve over time, organization leaders should openly include new questions and response options to reflect and recognize the diversity of the STEM community.

Inclusive survey questions and response options, alone, do not guarantee representative demographic data. Other aspects of surveys can prompt or prevent entire groups from responding, resulting in nonresponse biases. Response rates in general can be improved - and nonresponse bias reduced - by ensuring anonymity (e.g., de-linking surveys from member registration), sending reminders, minimizing survey length, and providing incentives (*11*, *14*). Furthermore, for sensitive questions, response rates may also benefit from providing a justification for data collection, such as that the results will influence specific R&R initiatives. It is our hope that the guides presented here will enable more STEM organizations to quantify demographic diversity among their constituencies and use the data to inform and evaluate R&R efforts. To improve capacity to compare the efficacy of R&R efforts, partnering STEM organizations may wish to develop compatible frameworks for data collection by first identifying a common survey program for survey design and benchmarking data, and then agreeing on the demographics questions and response options to ask constituents. With this collaborative approach to survey design, organizations can then share successful strategies for the R&R of specific groups, resulting in impactful and widespread support of underrepresented groups across STEM.

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Data and materials availability: All data used in this analysis are available through Dryad Digital Repository at https://doi.org/10.25338/B8N63K. The referenced survey programs are available at the following URLs: National Science Foundation's Survey of Earned Doctorates (SED), https://www.nsf.gov/statistics/srvydoctorates/; U.S. Census Bureau's American Community Survey (ACS), https://www.census.gov/programs-surveys/acs; Center for Disease Control and Prevention's National Health Interview Survey (NHIS), https://www.cdc.gov/nchs/nhis/index.htm and https://nhis.ipums.org/nhis/; Indiana University's National Survey of Student Engagement, https://nsse.indiana.edu/index.html; National Center for Transgender Equality's U.S. Trans Survey, https://www.ustranssurvey.org/