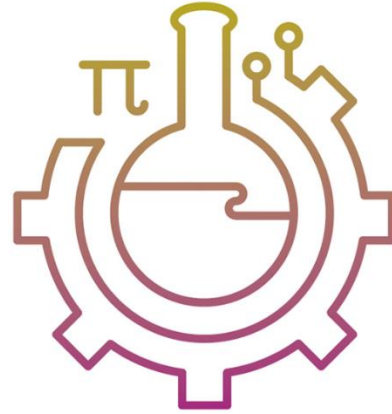


STEM

Inclusion Study



ORGANIZATION REPORT:
INSTITUTE FOR OPERATIONS RESEARCH AND THE MANAGEMENT SCIENCES
(INFORMS)

PRINCIPAL INVESTIGATORS:

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EXECUTIVE SUMMARY

The STEM Inclusion Study, led by Dr. Erin Cech (University of Michigan) and Dr. Tom Waidzunus (Temple University), is the first large-scale, national-level study to examine the experiences of women, racial and ethnic minorities (REM), persons with disabilities, and lesbian, gay, bisexual, transgender, and queer (LGBTQ) individuals working in the science, technology, engineering and math (STEM) workforce.¹ The study advances knowledge of the structures and cultures of STEM fields that may undermine equality of opportunities and outcomes on the basis of gender, racial/ethnic category, disability, and LGBTQ status. Overall, the goal of the study is to better understand processes of disadvantage experienced by members of STEM-related professional organizations in order to inform diversity and inclusion efforts of these organizations, as well as other STEM-related entities and institutions.

This organization participated in the survey phase of the STEM Inclusion Study, alongside a number of other STEM-related professional organizations.² With permission from the organization, the research team surveyed members of this organization on a variety of topics related to members' day-to-day experiences in their workplaces and their encounters with other STEM professionals. Using data from this survey, this report examines trends regarding (a) *experiences of inclusion and marginalization*, analyzing employees' perceptions of their workplace climate, feelings of personal fit, and harassment on the job; (b) *professional valuation*, the extent to which respondents believe they are respected and taken seriously as STEM professionals, and (c) *reports of workplace fairness*, the frequency with which respondents report instances of hostility and unfair treatment in their workplaces toward members of disadvantaged groups. We compare these reports of fairness across employment sector (for-profit, higher education, and other employment sectors),

and across disciplinary field (engineering, math and statistics, administration, and other disciplines) that make up the core employment categories of this organization.

Regarding *experiences of inclusion and marginalization*, persistent patterns emerged by gender, disability status, and race/ethnicity in this organization. Specifically, controlling for employment sector, education level, and age, women, persons with disabilities, and some racial/ethnic minority group members are significantly more likely to report experiences of marginalization in their workplace than their colleagues. A similar pattern emerged regarding *professional valuation*: women, persons with disabilities, and certain racial/ethnic minority group members are significantly more likely to report having their professional expertise devalued, receiving less respect from their supervisors and co-workers, and feeling as though they have to work harder than their colleagues to be seen as competent STEM professionals.

Regarding patterns of *workplace fairness*, organization members across different employment sectors reported witnessing or experiencing instances of negative treatment and harassment with some frequency: for instance, 20% of respondents reported witnessing negative treatment by gender in their workplaces in the last three years, and 14% reported witnessing negative treatment along the lines of race/ethnicity. These instances of negative treatment were reported more frequently among organization members working in higher education (2- and 4-year colleges and universities), compared to those employed among all other sectors. There are fewer systematic differences in these patterns across disciplines, but math and statistics appear to have the fewest instances of negative treatment and harassment, compared to other disciplines.

¹ The STEM Inclusion Study (<https://www.steminclusion.com/>) is funded by the National Science Foundation (#HRD 1535385, 1535360). Any opinions, findings, and conclusions or recommendations expressed in this material are those of the author(s) and do not necessarily reflect the views of the National Science Foundation.

² In total, the STEM Inclusion Study aims to include 15-20 professional organizations in total, seeking to maximize representation from organizations that represent the array of STEM disciplines, sectors, and industries. The names of the professional organizations are kept confidential to protect the confidentiality of individual survey participants.

This report begins with a brief introduction to inequality issues within the STEM workforce, then summarizes the survey results of

BACKGROUND

In both public and scholarly discourse, there is growing interest surrounding the retention and representation of certain socio-demographic groups in the STEM workforce. Investigating the processes of disadvantage that underrepresented groups in STEM face helps illuminate the factors that prevent talented and motivated individuals from advancing in STEM. Yet, scholars are only beginning to understand the particular mechanisms that reproduce these disadvantages within STEM workplace interactions, within STEM organizations, and within the contexts of science and engineering professional cultures. There is a pressing need for more research on these issues.

Investigations such as those undertaken by the STEM Inclusion Study are especially timely, as research over the last three decades has documented processes reproducing the underrepresentation of women, racial/ethnic minorities, LGBTQ persons, and persons with disabilities in science and engineering. Historically, women have been underrepresented in STEM in the United States (Iskander et al. 2013), and similar patterns are recorded in countries such as Korea, Switzerland, and Australia (Buccheria, Abt Gurber and Bruhwiler 2011). Women are less likely than men to enter STEM fields and more likely than men to leave them (Frehill 2012). In attempts to explain these gaps, research has not found any evidence of a performance gap between men and women (Koul, Lerdpromkulrat and Chantara 2011). Rather, stereotypes regarding who “fits” STEM are strongly connected to women’s underrepresentation in STEM, perpetuate “chilly” climates for women, and undermine the perception of women’s competence as STEM Professionals (Archer et al. 2013, Cech 2013, Cech et al. 2011, Cheryan et al. 2011). For instance, in a blinded study of science faculty hiring a student lab manager, men applicants were rated as more competent and likable than women applicants and offered higher salaries than women, even though

this organization and offers suggestions for addressing these issues.

the applicants had otherwise identical applications (Moss-Racusin et al. 2012). Among faculty populations, women tend to receive fewer resources, less mentoring, face greater criticism and isolation from peers, and are shouldered with more administrative and service work than men (McIlwee & Robinson 1991, NSF 2007).

Existing research has also detailed the experiences and challenges of racial/ethnic minorities in STEM fields. Racial/ethnic minorities (particularly African Americans and Hispanics) are highly underrepresented in STEM majors, in STEM faculty positions, and in STEM positions in industry, compared to their representation in US population more broadly (Babco 2003, Huradto et al. 2010). This underrepresentation is attributed to a range of issues, including unequal educational opportunities and mentoring (Moreno et al. 2006), implicit bias (Turner 2002, Moody 2004), and feelings of isolation within academic departments and communities (Zambrana et al. 2015). This underrepresentation of racial/ethnic minority faculty in STEM departments, furthermore, gives minority students the impression that they do not have a place in STEM or academic fields (Nelson and Brammer 2012). Thus, the underrepresentation of minority faculty and students in STEM are closely tied with one another—without mentors with whom minority students can relate, they are less likely to believe that they can be successful in STEM fields (Nelson and Brammer 2012). Less research has examined the experiences of racial/ethnic minority persons employed in STEM outside of academia, although there is reason to believe that experiences of marginalization and exclusion extend to non-academic sectors as well.

Scholars are only beginning to understand the experiences of LGBTQ individuals in STEM, but limited previous research indicates that LGBTQ persons frequently face marginalization and unfair treatment compared to their non-LGBTQ peers. Cumulatively, prior studies indicate the existence of negative climates for LGBTQ faculty and students in higher education and suggest a link between this climate and academic/career

consequences. A recent campus climate study of students, faculty and administrators revealed negative experiences for LGBTQ college students and faculty (Rankin et. al 2010). For example, 31 percent of LGBTQ students and faculty reported that they were not comfortable with the climate on their campus climate and 20 percent feared for their physical safety. Faculty and students in STEM departments specifically report similar, if not more extreme, experiences of marginalization in science and engineering departments (Cech 2013; Cech and Waidzunus 2011; Bilimoria and Stewart 2009; Gunckel 2009). Further, recent research on employees of STEM-related federal agencies found strong and persistent workplace experience inequalities for LGBTQ-identifying persons compared to their non-LGBTQ colleagues (Cech & Pham 2017).

Little is understood about the experiences of persons with disabilities in STEM education and employment as well. Early research suggests that STEM fields may be a particularly difficult and marginalizing environment for those with disabilities. Disability is often associated with negative stereotypes about intellectual ability; those with disabilities are often perceived as less intellectually competent than their peers (Slaton 2013). In STEM, this association is further compounded by the fact that STEM culture often silences discussions of bodily ability when evaluating performance (Knorr-Certina 1995, Siebers 2010, Slaton 2013).

Methodological Summary: In the spring of 2017, the STEM Inclusion Study fielded a confidential survey to this organization's membership list.³ Members were sent a pre-notification email in late May 2017, followed a week later by an email with a unique URL survey link. Participation in the survey was voluntary and individual responses are kept strictly confidential.⁴ The survey was kept open for a total of 8 weeks. All survey results below are presented in a way that ensures that any given individual's responses are not individually identifiable. Some students (N=433) also participated in the survey. For the purposes of this report, we focus only on the workplace experiences of organization members who were employed at the time of the survey.

Table 1 below presents the proportion of employed respondents by gender, race/ethnicity (respondents could identify with more than one racial/ethnic minority category), LGBTQ status, disability status, employment sector (university, for-profit, or other), and discipline (math and statistics, engineering, administration, or other specified discipline).

³ The membership list was provided to the research team via a secure online file sharing application. The membership list was used only for the purposes of this research. This organization's participation the study was approved by the University of Michigan Institutional Review Board.

³ Respondents participated in an online survey that took approximately 15-minutes to complete. The survey consisted of active members with a paid membership to this organization. The survey was distributed via a private email link, to 13,008 individuals. Survey participation: 2783, response rate: 21.4%. We include in this analysis only those non-student respondents who were employed at the time of

the survey and moved past the first question in the survey (N=1,591). Survey data was analyzed using Stata statistical programming package.

³ The category "women" includes both cis-gender and transgender women and the category "men" includes both cis-gender and transgender men.

³ Note: 11.73% of the sample identified as having a physical disability or chronic illness, and 3.5% of the sample identified as having a mental or emotional health difficulty.

Table 1: Descriptive Statistics of Sample by Demographic Characteristics (N=1,591)

Demographic Characteristics	Percent of the Sample
Female	28.50%
Male	70.85%
Hispanic	6.88%
Asian	25.40%
Black	2.55%
White	60.89%
Other Race/Ethnicity	5.95%
LGBTQ	3.10%
Disability (physical, mental or emotional difficulty)	15.23%
Employed at University or College	50.66%
Employed in for-profit sector	30.98%
Employed in other sector	18.36%
Broad discipline category: Math/Statistics	18.20%
Broad discipline category: Engineering	42.67%
Broad discipline category: Administration & Management	16.11%
Broad discipline category: Other	23.02%

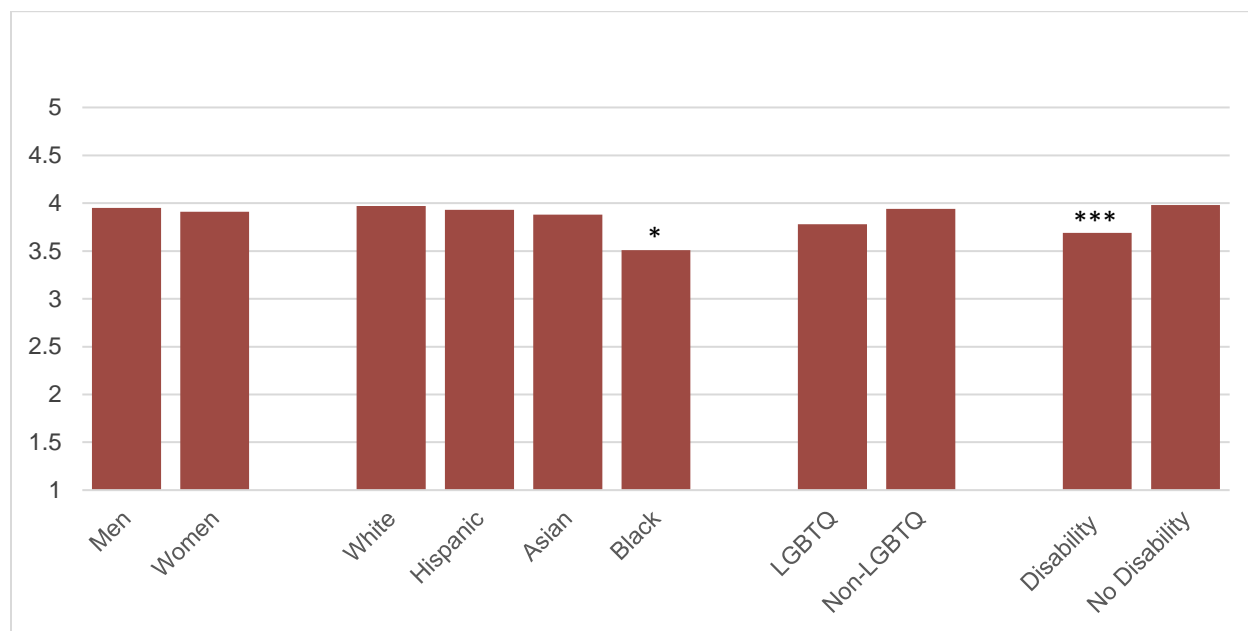
1. Inclusion and Marginalization

As noted above, previous research has found that women, racial/ethnic minorities, LGBTQ persons, and persons with disabilities in various places in STEM education and employment report more frequent experiences of marginalization and isolation than their colleagues (Frehill 2012, Cech 2013; Cech and Waidzunus 2011; Bilimoria and Stewart 2009; Gunckel 2009, CITES). This marginalization has consequences for long-term satisfaction and retention of these groups in STEM education and employment (Eglash 2002, Chang et. al 2008, Zambrana et. al 2015, Laschinger et. al 2005).

We explore patterns of inclusion and marginalization across demographic categories in this organization on five key indicators: (1) whether they feel like they fit in with other people in their workplace, (2) whether they have read or

heard insensitive comments in their organization in the last year, (3) whether they worry that their mistakes garner more visibility than those of their colleagues, (4) whether they have been harassed verbally or in writing in their workplace, and (5) whether they witnessed a co-worker making a negative comment or joke about women, a racial/ethnic minority, LGBTQ people, or people with disabilities. In this work, we consider each axis of marginalization independently. However, we recognize that within a theory of intersectionality (Crenshaw 1991), forms of marginalization across these dimensions are interlocking and interwoven. Our research aggregating data across professional societies in the STEM Inclusion Study will have a sample size large enough to explore intersectional effects.

Fig 1: “I feel like I fit in with other people in my workplace.”



Predicted Probabilities by gender, race/ethnicity, LGBTQ and disability status, net of differences by sector, age, and education level. (1=strongly disagree to 5=strongly agree)

Figure 1 represents respondents’ feelings of “fit” in their current workplace among other employees (values range from 1-5, 1=Strongly Disagree through 5=Strongly Agree). The values are predicted probabilities—the means for each group holding variation by age, sector, and education level constant.

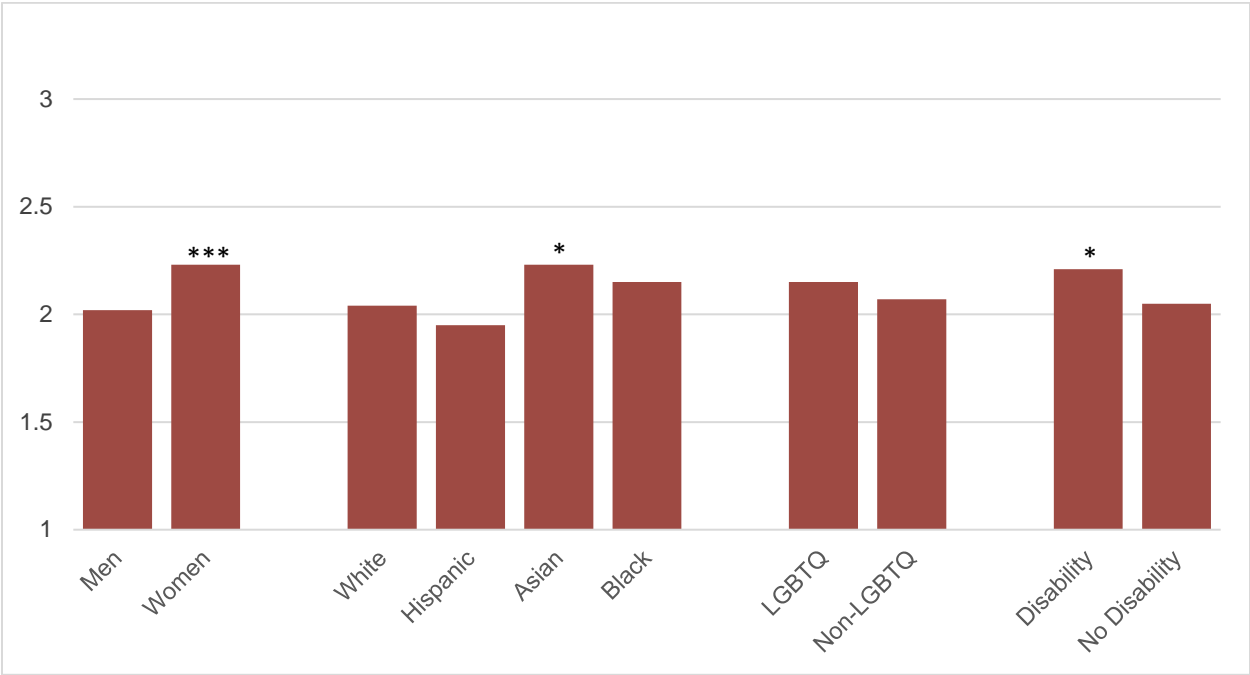
Overall, the averages among all demographic groups were relatively high, with respondents feeling on average between “Neither Disagree nor Agree” and “Agree” in regards to fitting in with others at their work.

However, there are several significant differences on this measure of marginalization, as indicated by the asterisks above the bars (** $p < .001$, ** $p < .01$, * $p < .05$, † $p < .10$, two-tailed test).⁵ First, compared to white respondents, black respondents are significantly less likely to report that they feel like they fit in their workplace. Black respondents’ averages were also among the lowest of any other demographic group, including race/ethnicity. Furthermore, disabled respondents were significantly less likely than those without disability to report that they fit in.

⁵ Significance levels were determined by logistic, OLS, or ordered logistic regressions (depending on the dependent variable in question) that included measures for gender, racial/ethnic category, LGBTQ status, age, disability status,

education level and employment status. These models were multiply imputed (20 imputations using the chained command in Stata) so that all figures have an N=1,591.

Fig 2: “I have read or heard insensitive comments in my workplace that I found offensive.”

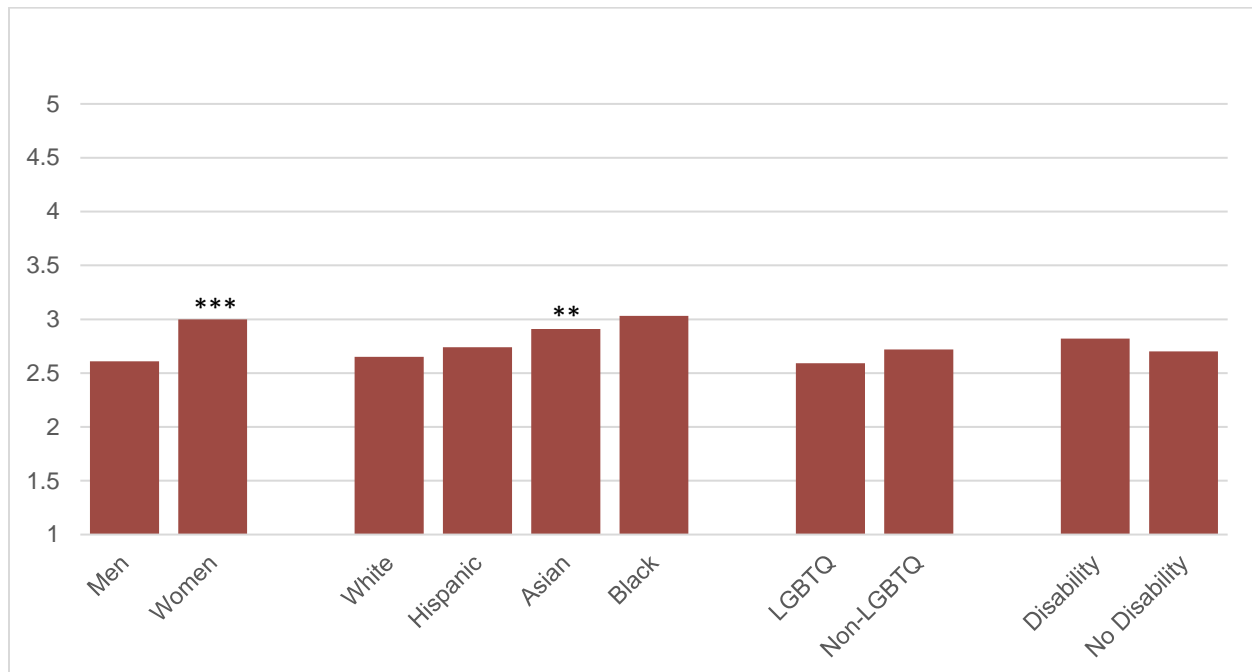


Predicted Probabilities by gender, race/ethnicity, LGBTQ and disability status, net of differences by sector, age, and education level. (1=Never, 2=At least once in the past year, 3=At least once a month or more)

This second measure indicates whether some groups are significantly more likely than others to have encountered insensitive or offensive comments in their workplaces. Such comments are an important mechanism of marginalization in workplace. Overall, across demographic groups in this organization, most respondents reported encountering an offensive comment at least once in the past year.

More specifically, women were significantly more likely than men to report witnessing an offensive comment at least in the last year. Asian respondents were significantly more likely than white respondents to report the same. Lastly, respondents with mental, emotional, and/or physical disabilities were significantly more likely than those without disability to encounter insensitive comments at least in the last year. Although there are some differences in the means across other demographic categories, these differences are not statistically significant.

Fig 3: “I worry that my mistakes are more noticeable than the mistakes of others.”

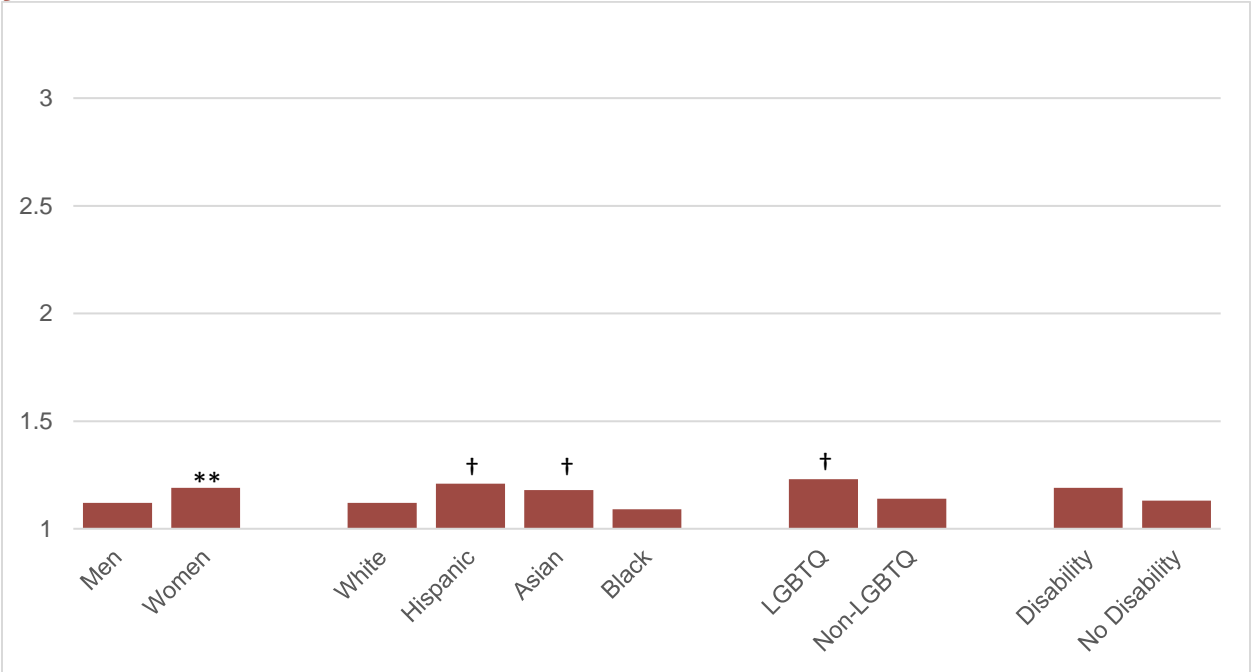


Predicted Probabilities by gender, race/ethnicity, LGBTQ and disability status, net of differences by sector, age, and education level. (1=strongly disagree to 5=strongly agree)

Another important indicator of marginalization is the extent to which disadvantaged group members fear that their mistakes will be more visible than those of their colleagues. In the figure above, there are several significant group differences: net of variation by sector, discipline, education level, and age, women

are significantly more likely than men to worry that their mistakes garner more negative attention than their colleagues. Asian respondents were also significantly more likely than white respondents to be concerned about noticeable mistakes. No other demographic differences were statistically significant.

Fig 4: “I was harassed verbally or in writing on the job in the last year.”



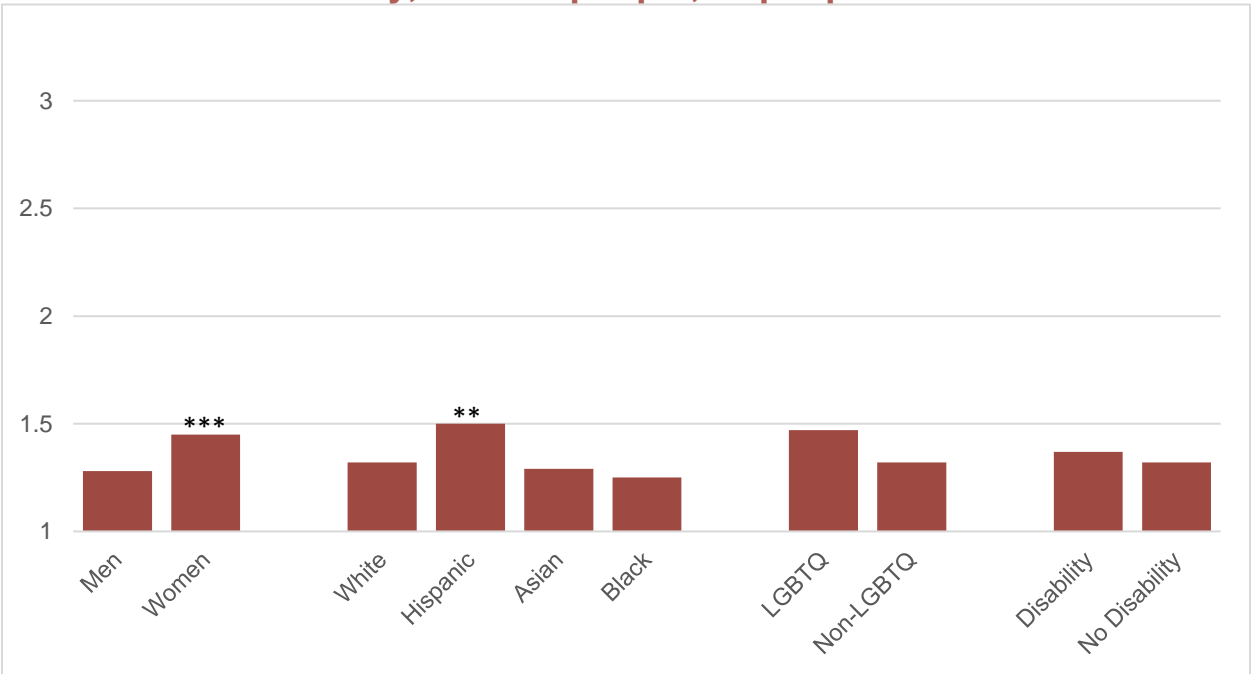
Predicted Probabilities by gender, race/ethnicity, LGBTQ and disability status, net of differences by sector, age, and education level. (1=Never, 2=At least once in the past year, 3=At least once a month or more)

Overall, as indicated in Fig 4, experiences of direct harassment are relatively rare. However, women were significantly more likely than men to report experiencing harassment at work in the last year.

Hispanic and Asian respondents were also marginally significantly more likely than white respondents to report harassment in the last year.

Finally, LGBTQ respondents were marginally significantly more likely than non-LGBTQ respondents to report such experiences. These differences are significant net of variation by age, sector, discipline, and education level.

Fig 5: “A co-worker makes a negative comment or joke about women, a racial/ethnic minority, LGBTQ people, or people with disabilities.”



Predicted Probabilities by gender, race/ethnicity, LGBTQ and disability status, net of differences by sector, age, and education level. (1=Never, 2=Once in a While, 3=Sometimes or Frequently).

Figure 5 depicts an aggregated measure which reports the frequency to which respondents reported hearing offensive comments about specific groups in the workplace (1=Never to 3=sometimes or frequently). Overall, few respondents reported hearing targeted negative comments from co-workers toward any of the listed groups.

However, women were significantly more likely than men to report hearing a co-worker make such a comment or joke at work. Lastly, Hispanic respondents were also significantly more likely than white respondents to report encountering a targeted comment from a co-worker. No other differences were statistically significant.

Summary of Patterns of Marginalization

Several strong demographic patterns emerged among the marginalization measures above. The most persistent pattern was along the lines of gender: women respondents consistently reported more frequent experiences of marginalization in their workplaces than men net of other demographic and work characteristics. These gender differences emerged on 4 out of 5 marginalization measures we include in our analysis. For example, women were significantly more likely than men to report witnessing offensive comments in their workplace, significantly more likely than men to report being harassed at work, and significantly more likely to state that they worried their mistakes were more noticeable than others. These results point to a concerning pattern of institutional marginalization of women INFORMS members in their workplaces.

Another consistent pattern that emerged is the marginalization experienced by people of color. A number of respondents from various racial/ethnic groups had significantly more negative outcomes than whites on various measures. For example, Asian respondents were significantly more likely than white respondents to witness insensitive and offensive comments in the workplace, significantly more likely than white

respondents to worry that their mistakes were more noticeable, and were marginally more likely than whites to report harassment at work. Hispanic respondents were marginally more likely than whites to report harassment at work, and significantly more likely than whites to report a “chilly climate.”

Lastly, black respondents were significantly more likely than white respondents to report fitting in at their job. These patterns demonstrate various experiences of racial/ethnic exclusion and marginalization for racial/ethnic minority members of this organization.

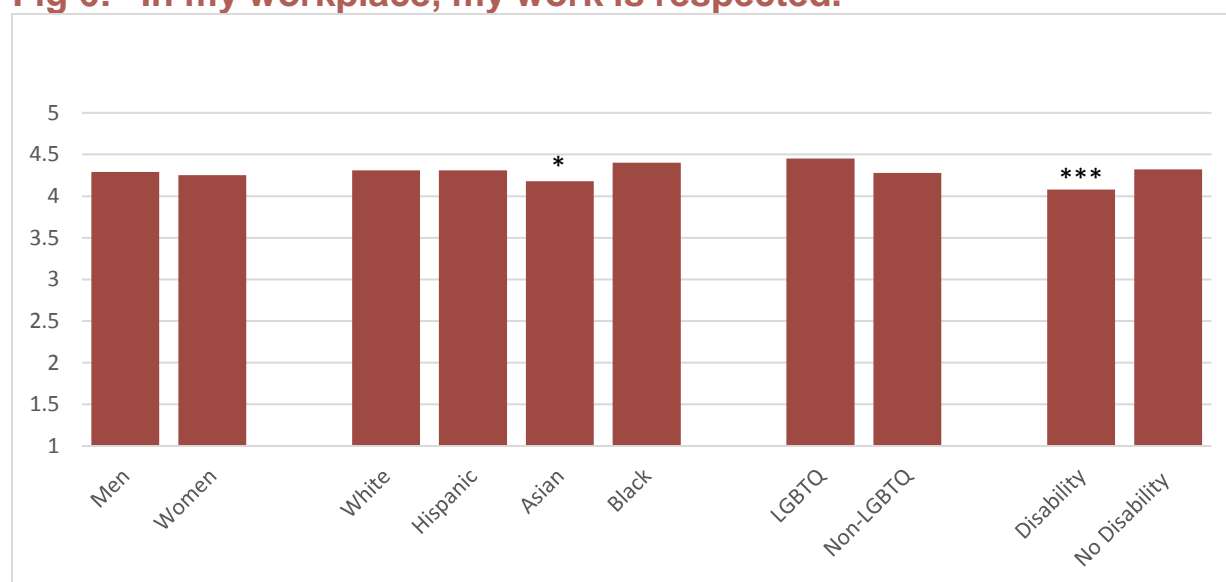
Finally, several patterns were present among persons with physical, emotional, or mental disabilities and LGBTQ persons. Respondents with one or more disabilities were significantly less likely than their otherwise similar peers to feel that they fit in at their workplaces and significantly more likely than their nondisabled peers to read or hear offensive comments at work. LGBTQ individuals were marginally more likely than non-LGBTQ respondents to report harassment at their job. These patterns point to an important point of consideration for this organization in ways to advocate for the interests of its members.

2. Professional (De)valuation

Prior research has found that disadvantaged groups within STEM often experience that their colleagues question their scientific and engineering competence and performance (Moss-Racusin et al. 2012, Steele 2003, Chang et al. 2008, Williams 2014). Disparities in the recognition of the professional excellence of women, people of color, and LGBTQ individuals in STEM exacerbate the disciplinary issues of underrepresentation and attrition in STEM education and careers (Shapin 1995, Collins and Evans 2007, Williams 2014, Steele 2003, Chang et al. 2008, Nelson and Brammer 2012).

In this section, we examine five important indicators of professional devaluation: (1) whether they believe their work is respected in their workplace, (2) whether they believe their supervisor respects them, (3) whether they believe they are held to the same standard as their colleagues, (4) whether their boss gives them less credit than they deserve, and (5) whether they believe they have to work harder than their colleagues to be perceived as legitimate professionals.

Fig 6: “In my workplace, my work is respected.”



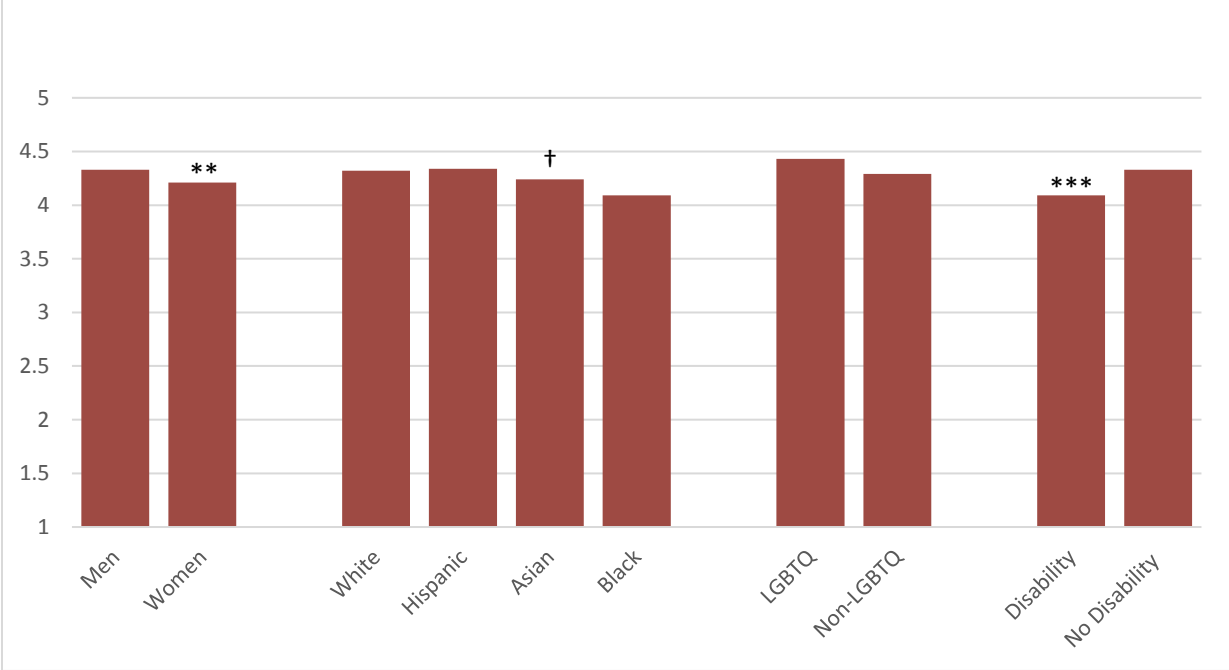
Predicted Probabilities by gender, race/ethnicity, LGBTQ and disability status, net of differences by sector, age, and education level. (1=strongly disagree to 5=strongly agree)

As above, the bar charts in this section present the predicted means for each demographic category, net of variation by age, education level, and sector. The asterisks represent significant differences across those categories, as determined by OLS or ologit regression models (** $p < .001$, ** $p < .01$, * $p < .05$, † $p < .10$, two-tailed test).

Figure 6 captures the extent to which respondents feel as though their work is respected within their workplaces (1-5; 1=Strongly

Disagree, 5=Strongly Agree). Respondents typically feel that their professional work is respected—answers lie on average between somewhat and strongly agree. However, there are two important demographic differences in this respect: Asian respondents are significantly less likely than white respondents to report that their work is respected, and persons with disabilities are significantly less likely than their counterparts without disabilities to report that their work is respected by their workplace colleagues.

Fig 7: “My supervisor treats me with respect.”

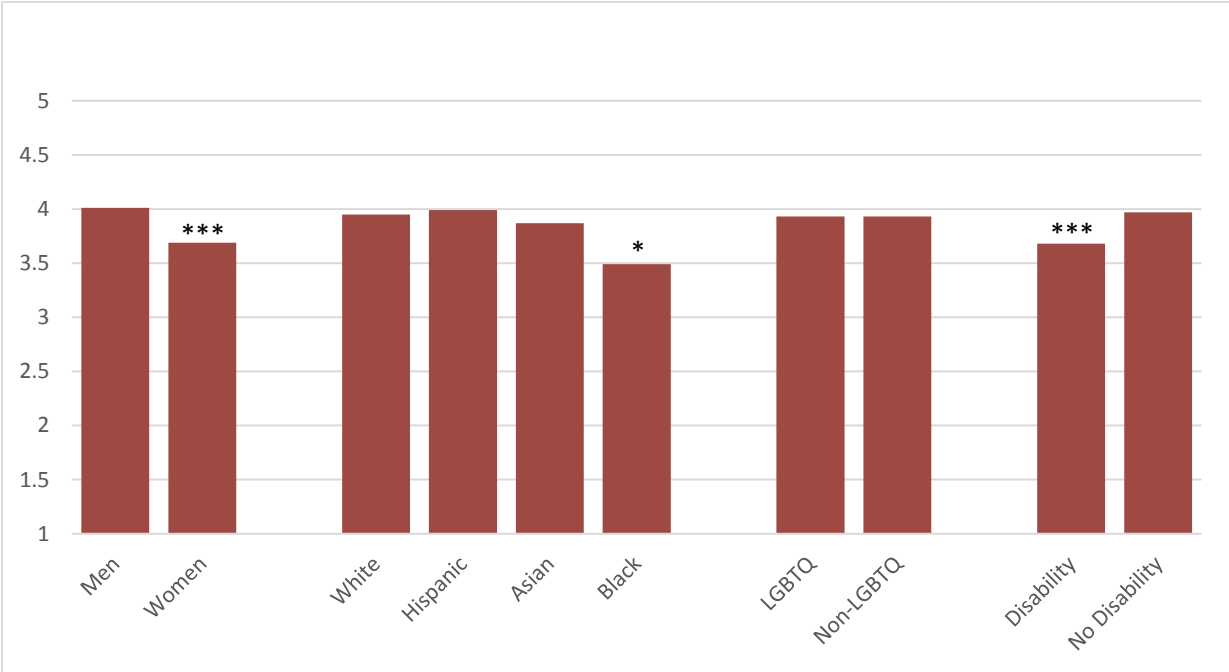


Predicted Probabilities by gender, race/ethnicity, LGBTQ and disability status, net of differences by sector, age, and education level. (1=strongly disagree to 5=strongly agree)

The second measure captures whether respondents feel respected by their supervisors (Fig 6). In general, respondents typically report that they experience at least a certain degree of respect from their supervisors. All groups’ averages were higher than 4, “Somewhat Agree.” However, as depicted above, there is distinct demographic variation in this level of professional respect.

Specifically, women are significantly less likely than men with the same education level, the same age, and in the same sector to report that their supervisors respect their work. Disabled respondents are also significantly less likely than those without disability to report that their supervisors respect their work. Similarly, Asian respondents are marginally significantly less likely than their white counterparts to report that their supervisors respect them.

Fig 8: “I am held to the same standard as others for promotion and advancement.”

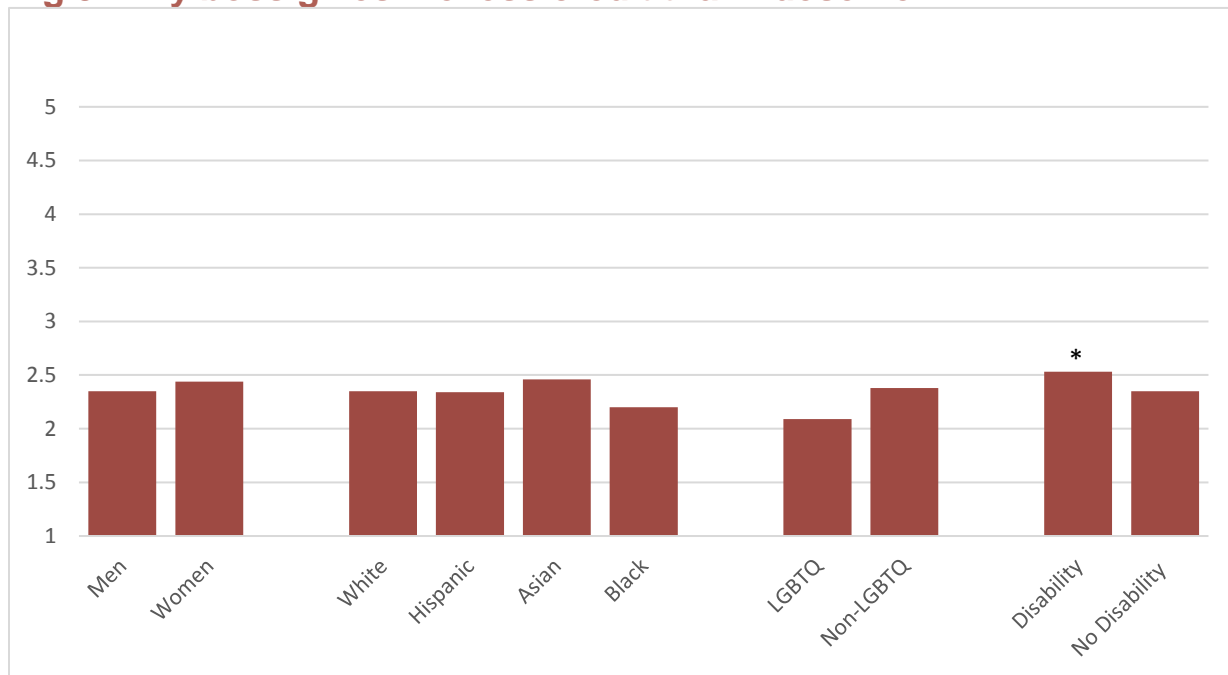


Predicted Probabilities by gender, race/ethnicity, LGBTQ and disability status, net of differences by sector, age, and education level. (1=strongly disagree to 5=strongly agree)

Another important indicator of professional respect is the extent to which respondents believe that they are held to the same standard for advancement and promotion than their colleagues (Fig 7). Those who feel that they are held to a higher standard may not advance as quickly, and are not given the same level of respect for the same quality of work.

Consistent with the results above, women are significantly less likely than men to report that they are held to the same standard as their colleagues in their workplaces. Persons with disabilities are significantly less likely to report the same. Lastly, black respondents are significantly less likely than white respondents to report being held to the same standards for promotion and advancement in their workplace.

Fig 9: “My boss gives me less credit than I deserve.”

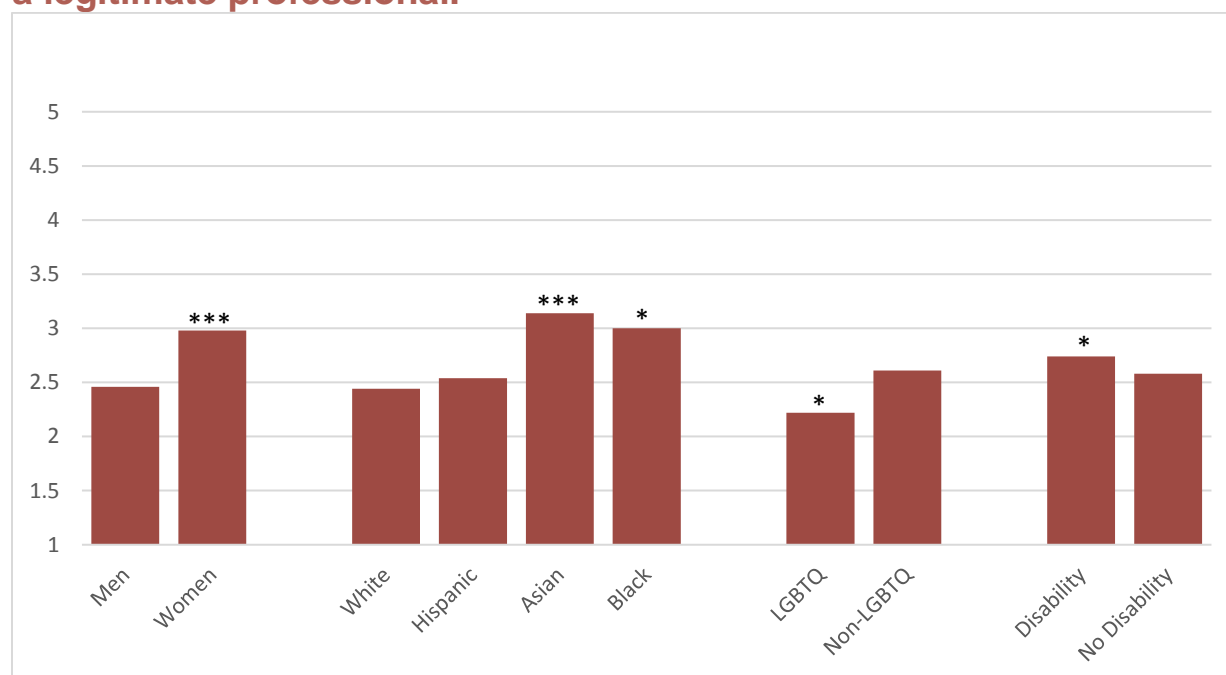


Predicted Probabilities by gender, race/ethnicity, LGBTQ and disability status, net of differences by sector, age, and education level. (1=strongly disagree to 5=strongly agree)

Similar to the measures above, Figure 9 reports the extent to which respondents agree that their boss gives them less credit than they deserve. In general, respondents typically disagree with this statement: the average sits between “somewhat disagree” and “neutral.”

Yet, as before, there are important demographic differences to note: respondents with disabilities are significantly more likely than people without disabilities to agree that their boss gives them less credit than they deserve.

Fig 10: “I have to work harder than my colleagues to be perceived as a legitimate professional.”



Predicted Probabilities by gender, race/ethnicity, LGBTQ and disability status, net of differences by sector, age, and education level. (1=strongly disagree to 5=strongly agree)

As a final measure of professional valuation, Figure 10 above reports the predicted means on a measure that asks respondent the extent to which they agree that they have to work harder than their colleagues to be perceived as a legitimate professional. As a whole, responses mostly average between “disagree” and “neutral.”

But, as before, there is important variation between demographic groups within this organization, net of education, sector, discipline, and age. Specifically, women are significantly more likely than men, Asian and black respondents are significantly more likely than white respondents, and respondents with disabilities are significantly more likely than respondents without to agree that they have to work harder to be perceived as a legitimate professional.

LGBTQ respondents were also significantly less likely than non-LGBTQ respondents to report needing to work harder to be viewed as a professional. In supplemental analyses, we find that this effect is primarily driven by LGBTQ-identifying women, who are less likely than non-LGBTQ women to report that they have to work harder than their colleagues to be perceived as a legitimate professional. Although this finding will be the subject of more research, this aligns with qualitative research that suggests that non-heterosexual women may be seen as more competent in STEM fields than heterosexual women because of the latter’s greater association with stereotypical forms of femininity (which is devalued in STEM) (Cech & Waidzunus 2011).

Summary of Patterns of Professional Devaluation

Among the measures of professional devaluation category, we see similar trends as those reported in the measures relating to marginalization. However, for this section, disability was the strongest pattern observed—individuals with a disability have significantly more negative values on all measures in this category: respondents with a disability are significantly less likely than those without to report that their work is respected, significantly less likely to agree that their supervisor treated them with respect, significantly less likely to report that they are held to the same standard for promotion as others, significantly more likely than non-disabled respondents to report that their boss gives them less credit than they deserve, and significantly more likely than those without disability to report that they had to work harder than their colleagues to be viewed as a professional. Such results demonstrate a pervasive feeling of devaluation in their workplaces by members of this organization with disabilities. These differences are net of variation in the sample by education level, age, and employment sector.

Once more, gender, racial/ethnic related patterns of devaluation were also significant. Women were significantly less likely than men to report that their supervisor treats them with respect, significantly less likely to report that they are held to the same standards as their colleagues for promotion, and significantly more likely to feel that they have to work harder than their colleagues to be perceived as a legitimate professional.

Asian respondents were significantly more likely than white respondents to report having to work harder than colleagues, significantly less likely than whites to agree that their work is respected in their workplace, and marginally less likely than whites to agree their supervisor treated them with respect. Black respondents were significantly less likely than white respondents to believe they were held to the same standard of promotion, and significantly more likely than whites to report having to work harder than colleagues.

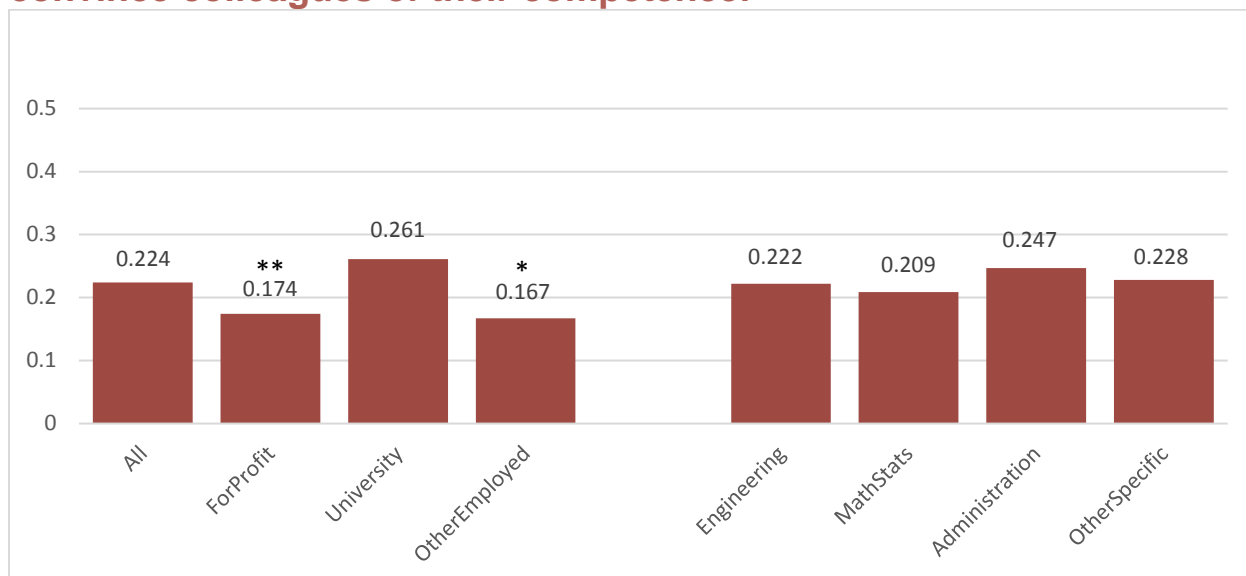
3. Patterns of workplace fairness across sectors and disciplines

In the sections above, we compared experiences of marginalization and professional devaluation across demographic categories, controlling for variation for several work factors, including employment sector. However, members of this organization work across a variety of employment sectors (e.g., universities, for-profit companies) and in various disciplines (e.g., engineering, administration, math and statistics); the climate for disadvantaged groups may vary considerably across these axes. As such, this section compares indicators of chilly climates (by gender, race/ethnicity, LGBTQ status and

disability status) across different employment sectors and disciplines. It allows us to ask, are certain sectors and disciplines more positive for under-represented members of this organization than others?

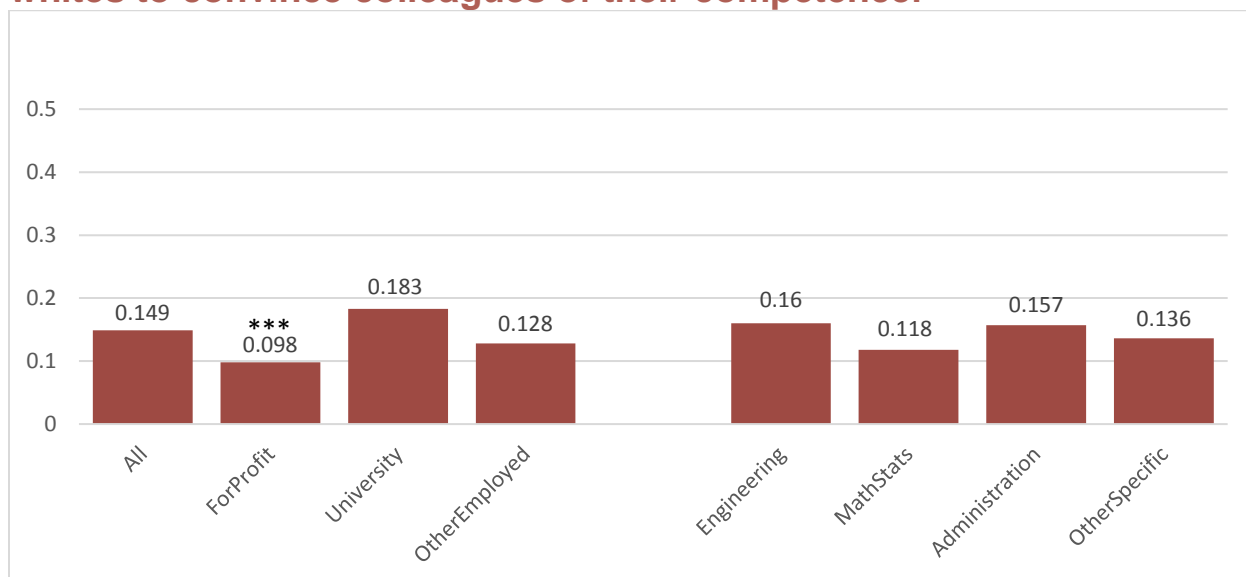
The three figures below present the proportion of respondents in each sector and each disciplinary group who agree that women, racial/ethnic minorities, and LGBTQ persons must work harder than others to convince their colleagues of their competence.

Fig 11: Proportion of respondents by sector and discipline agreeing that “Women in my workplace must work harder than men to convince colleagues of their competence.”



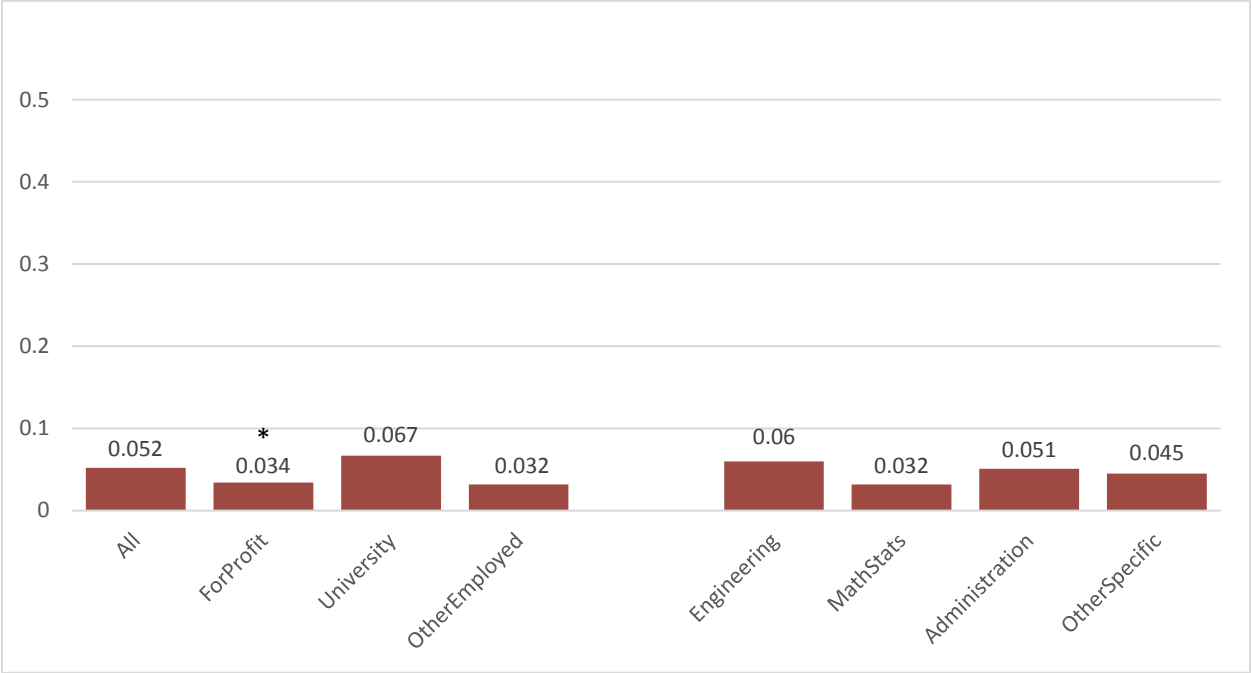
Predicted Probabilities by employment sector and by discipline. (proportion who agree between 0 and 1). University is the comparison category for sector; Engineering is the comparison category for discipline.

Fig 12: Proportion of respondents by sector and discipline agreeing that “Racial/ethnic minorities in my workplace must work harder than whites to convince colleagues of their competence.”



Predicted Probabilities by employment sector and by discipline. (proportion who agree between 0 and 1). University is the comparison category for sector; Engineering is the comparison category for discipline.

Fig 13: Proportion of respondents by sector and discipline agreeing that “LGBTQ individuals in my workplace must work harder than non-LGBTQ persons to convince colleagues of their competence.”



Predicted Probabilities by employment sector and by discipline. (proportion who agree between 0 and 1). University is the comparison category for sector; Engineering is the comparison category for discipline.

The figures above represent the predicted probabilities of the proportion of respondents in each sector who agree with each statement, holding constant variation by demographics (gender, race/ethnicity, age, disability status, LGBTQ status, and education level). The asterisks indicate (1) significant differences between the university sector (which includes 4-year and 2-year colleges and university) and the other sectors: the for-profit private sector and an “other sectors” category that includes non-profit and governmental sectors —depicted in the four left bars on the graphs; and (2) significant differences between respondents employed in engineering disciplines versus the three other disciplinary categories: math and statistics, management and administration, and other disciplines—depicted in the four rightmost bars on the graphs. Significance levels are determined by logistic regression models; see footnote 5 for more details (**p<.001, *p<.01, †p<.10, two-tailed test).

Starting with the first figure in this section, Figure 11, the leftmost column in the

graph displays the proportion of respondents overall (22%) who report that women have to work harder than men to convince colleagues of their competence. There is also significant variation in this outcome across sectors: those employed in the for-profit sector (17%) and other sectors (17%) were significantly less likely than those in the university sector to report such workplace standards for women. In regard to the specific disciplines of members within this organization, there were no significant differences. Among all disciplines (engineering, math and statistics, administration, and other), between 20% and 25% of respondents agree that women have to work harder men in their workplaces.

Figure 12 presents results on a question that asks about workplace fairness for people of color in respondents’ employing organizations. Across all employment sectors, 15% of respondents say that racial/ethnic minorities have to work harder than whites in their organization to be seen as competent professionals. As before, the proportion of

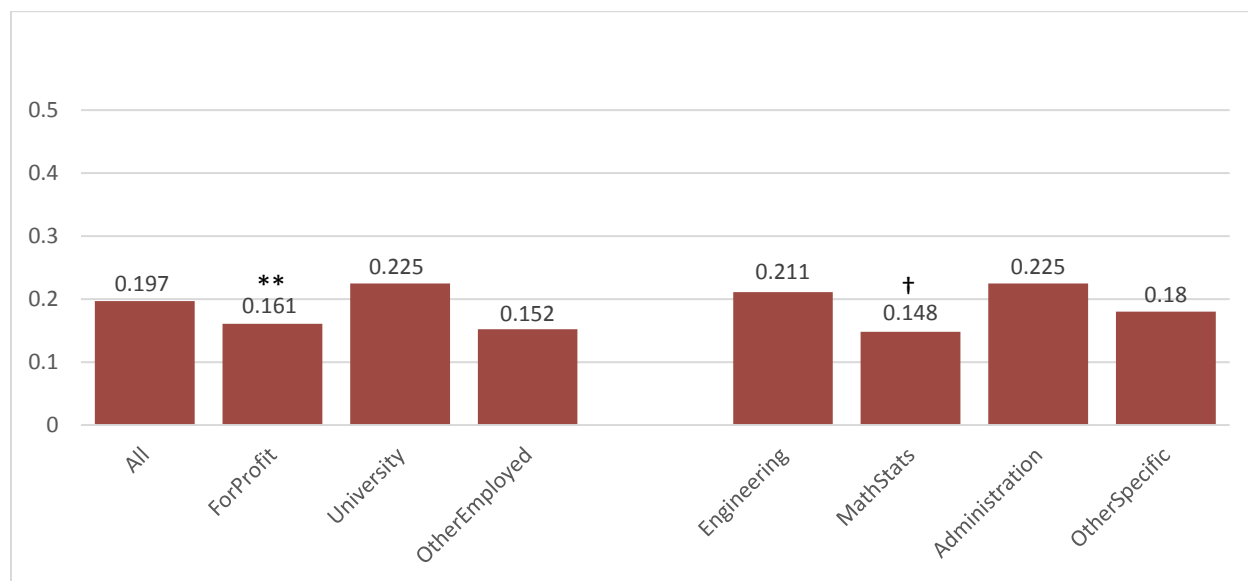
respondents agreeing with this measure is highest in the university sector (18%) and significantly lower (9.8%) in the for-profit sector. There are no significant differences on this measure across disciplinary categories. The averages for agreeing with this measure ranged from 12% for respondents in math and statistics to 16% in engineering.

Although LGBTQ status is not always able to read off the body, as gender and race/ethnicity often are, workers still may witness differential treatment of out LGBTQ colleagues in their workplaces (Cech & Rothwell 2017). Figure 13 indicates that 5% of respondents across employment sectors report that LGBTQ persons in their work environment have to work harder than their non-LGBTQ colleagues to convince colleagues of their competence. Once again, the for-profit sector is significantly less likely (3.4%) than the university sector—the comparison category—to report this type of experience for LGBTQ workers. Among the disciplines within this organization, there were no significant differences, and averages ranged from 3.2% for those in math and statistics to 6% for members in engineering.

Note that these figures represent respondents (women and men, whites and people of color, LGBTQ and non-LGBTQ respondents) reporting on the climate of their employing organizations. To see how men and women report on their own experiences, see results in part 1 and 2 above. Also note that these results are best understood relationally: they show which sectors and disciplines seem to have the strongest or weakest patterns of chilly climates. Worker-reported estimates of workplace bias in workplaces tend to underestimate the level of bias in the organization overall.

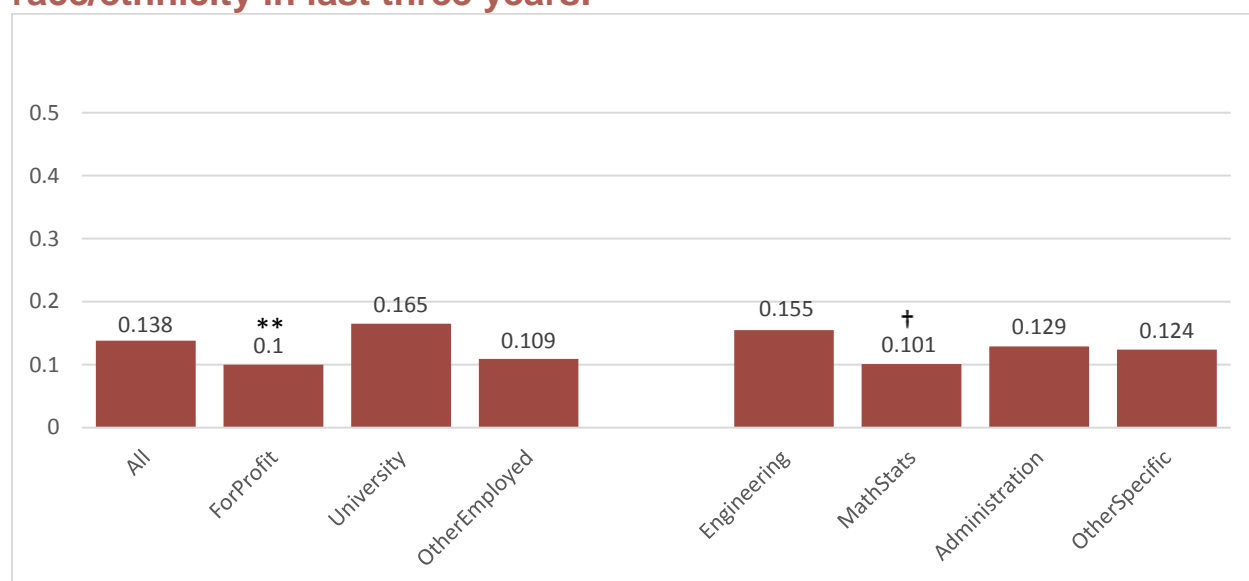
Figures 14-17 below present the proportion of respondents in each employment sector and discipline who report having witnessed persons in their workplace being treated differently based on their demographic category.

Fig 14: Proportion of respondents by sector and discipline who reported witnessing person(s) being treated differently due to gender in last three years.



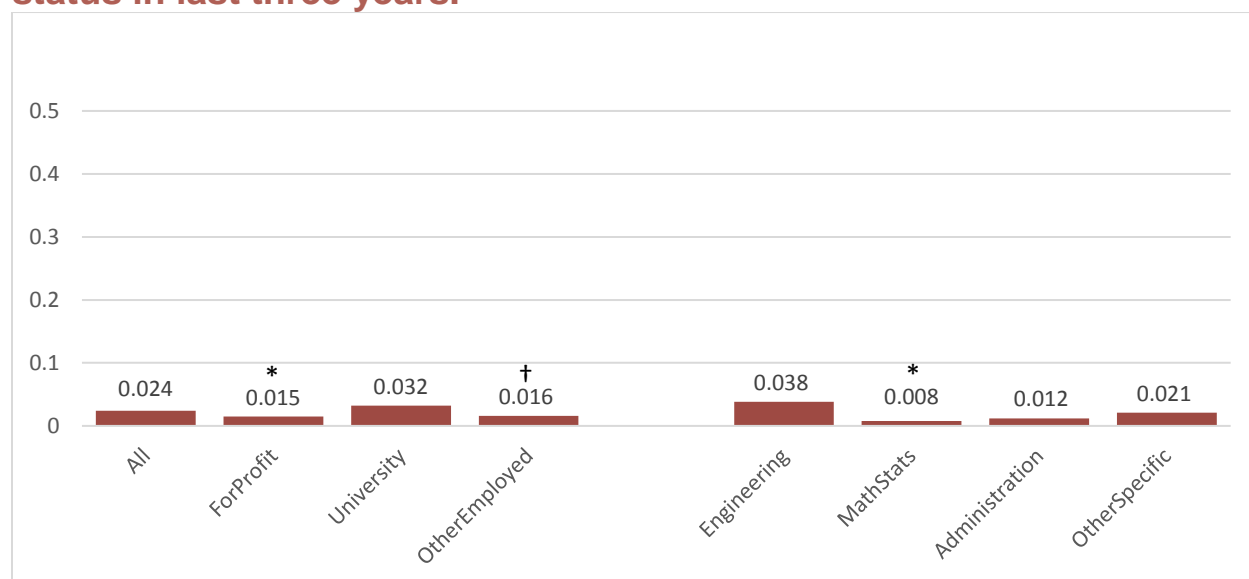
Predicted Probabilities by employment sector and by discipline. (proportion who agree, between 0 and 1). University is the comparison category for sector; Engineering is the comparison category for discipline.

Fig 15: Proportion of respondents by sector and discipline who reported witnessing person(s) being treated differently due to race/ethnicity in last three years.



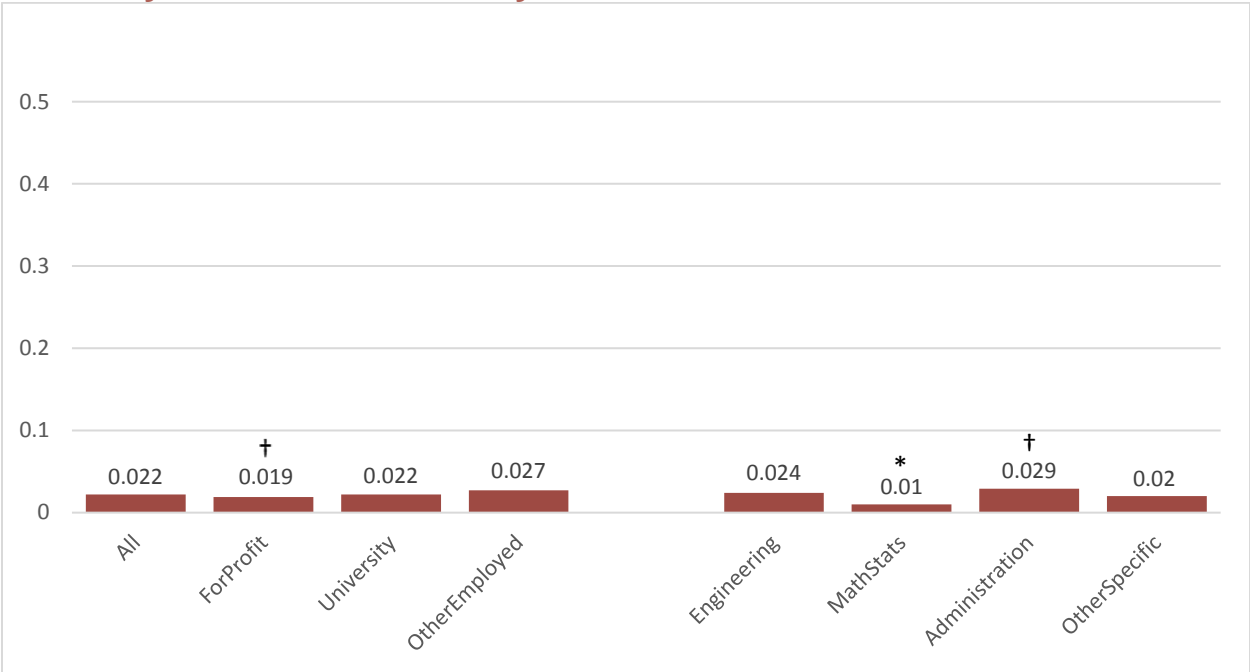
Predicted Probabilities by employment sector and by discipline. (proportion who agree, between 0 and 1). University is the comparison category for sector; Engineering is the comparison category for discipline.

Fig 16: Proportion of respondents by sector and discipline who reported witnessing person(s) being treated differently due to LGBTQ status in last three years.



Predicted Probabilities by employment sector and by discipline. (proportion who agree, between 0 and 1). University is the comparison category for sector; Engineering is the comparison category for discipline.

Fig 17: Proportion of respondents by sector and discipline who reported witnessing person(s) being treated differently due to disability status in last three years.



Predicted Probabilities by employment sector and by discipline. (proportion who agree, between 0 and 1). University is the comparison category for sector; Engineering is the comparison category for discipline.

As in the previous section, Figures 14-17 present the proportion of respondents in each employment sector and discipline who report that they have observed women (Fig. 14), racial/ethnic minorities (Fig. 15), LGBTQ persons (Fig. 16) and persons with disabilities (Fig. 17) being treated differently in their workplace on the basis of these statuses. Significance levels indicate statistically significant differences between respondents in the university sector versus other employment sectors and between respondents in engineering vs. other disciplines, as determined by logistic regression models; see footnote 5 for more details (**p<.001, *p<.01, p<.05, †p<.10, two-tailed test).

Figure 14 depicts the frequency with which respondents reported that they observed a person or persons being treated differently in their workplace due to gender in the last three years. Among all employment sectors, 20% of all respondents report witnessing instances where someone was treated differently on the basis of

gender in their organization in the last three years. Nearly a fourth (23%) of respondents in the university sector reported witnessing differential treatment on the basis of gender in the last three years. The climate in other sectors appeared to be better: those in for-profit employment were significantly less likely than the average of all workplaces to report gender-based differential treatment (16%). Lastly, those employed in other sectors were also significantly less likely than university employees to report the same. Note that these employment sector differences are net of variation by demographic categories (gender, race/ethnicity, etc.). As for discipline specific differences, 23% of those in administrative sectors and 21% of those in engineering reported witnessing differential treatment because of gender. Those in math and statistics were significantly less likely to witness gender-based differential treatment than those in the discipline of engineering.

The next figure (Fig. 15) presents the frequency with which respondents have observed differential treatment on the basis of race/ethnicity in their workplaces. Among respondents in the average of all sectors, 14% reported at least one instance of race/ethnicity based differential treatment in their workplaces in the last three years. Those employed in for-profit workplaces were significantly less likely (at 10%) than those among all workplaces to witness race/ethnicity based treatment. In regards to discipline, respondents in the fields of math and statistics were marginally less likely than those in engineering to witness race/ethnicity based differential treatment.

Figure 16 depicts the proportion of respondents who reported observing differential treatment in their workplace on the basis of LGBTQ status. As before (possibly due to the frequent invisibility of LGBTQ status), a comparatively low proportion of respondents across workplace sectors reported observing LGBTQ-based differential treatment—2.4%. This number was significantly lower for those in the for-profit sector (1.5%) and marginally lower in other sectors (1.6%) than in the university sector. Further, in regard to discipline, those employed in math and statistics were significantly less likely than those in engineering to report witnessing LGBTQ-based differential treatment.

Finally, Figure 17 presents the proportion of respondents who reported that they observed differential treatment on the basis of disability status. Among respondents across all employment sectors, 2.2% reported witnessing an instance of disability-based differential treatment in the last 3 years. For-profit employees were marginally less likely to report such instances (1.9%) than the university sector. Meanwhile, those in the discipline of math and statistics were significantly less likely (1%) than those in engineering (2.4%) to witness disability-based differential treatment, and those in administration were marginally more likely (2.9%) than engineering to report the same.

As before, these results are best understood relationally—to see patterns of workplace fairness by employment sector and discipline and identify which sector(s) and discipline(s) have the most frequent incidences of

bias. People typically under-report harassment and differential treatment in their organizations, so these should be taken as conservative estimates of the actual bias occurring in these workplaces. To see how different demographic groups report on their own experience of bias, see Parts 1 and 2 above.

Summary of Patterns of Workplace Fairness

Part 3 of this report presented patterns of workplace fairness by employment sector (for-profit, university, and other sectors) and professional discipline (engineering, math and statistics, administration, and other). Among these sectors, employees in the for-profit sector were consistently and significantly lower on these unfairness measures than the other sectors. For example, 17% of for-profit employees agree that women must work harder than men to convince colleagues of their competence as compared to 26% of university employees. 10% of for-profit employees, 18% of university employees, and 13% of those at other workplaces feel that racial/ethnic minorities should do the same. 23% of university employees saw different treatment due to gender whereas 16% of for-profit and 15% of other employed said the same. Such findings indicate that patterns of disadvantage are particularly strong among this organization's respondents within the academic sector, and lesser within for-profit and other sectors.

As for disciplinary differences, respondents in math and statistics (15%) were marginally significantly less likely than those in engineering (21%) to report gender harassment. Respondents in math and statistics (1%) were significantly less likely than those in engineering (2.4%) to report harassment toward disabled individuals, those of LGBTQ status, and harassment of racial/ethnic minorities.

Overall, the most positive indicators of fair treatment and harassment occurred in the for-profit sector and those in the disciplines of math and statistics. The university sector had the most consistently negative outcomes across most measures.

SUMMARY OF FINDINGS

The results from this survey point to both positive and negative aspects of diversity and inclusion as experienced by members of this professional organization. First, harassment rates in general are relatively low, and respondents across demographic groups generally felt their work is respected by their colleagues and that their supervisors treat them with respect. Respondents on average generally do not believe their boss gives them less credit than they deserve, nor that they have to work harder than others to be given the same professional recognition. Further, most respondents reported a general feeling of fit within their workplace. Most respondents in this organization did not report high levels of LGBTQ bias in their workplace (although it is not clear whether this is due to the lack of visibility of LGBTQ status vis a vis other demographic characteristics like gender and race/ethnicity). Lastly, the majority of respondents did not observe instances of chilly climates toward persons with disabilities. While these general trends suggest that members of this organization tend to have positive experiences in their workplaces, these patterns differed substantially across demographic category.

The survey results pointed to several concerning trends regarding the marginalization and professional valuation of under-represented members of this organization. We find pervasive gender differences in workplace experiences: women had significantly more negative experiences on *the majority of measures* in our analysis, net of variation by age, education level, employment sector, discipline and other demographic factors. Similarly, persons with disabilities and racial/ethnic minority respondents reported significantly more negative experiences than their peers across a number of different marginalization and professional devaluation measures. LGBTQ status, to a lesser extent, also was a factor in marginalization.

Regarding experiences of marginalization, women, persons with disabilities, black, Hispanic, and Asian respondents had more experiences of marginalization than men, persons without disabilities, and white respondents respectively. Most of these patterns were echoed in the

professional devaluation measures, whereby women, persons with disabilities, and black and Hispanic respondents more frequently reported that their competency and value was questioned in their workplace. Our results show that the most consistently negative diversity and inclusion issues occurred in the university sector and the most consistently positive results in the for-profit sector. Meanwhile, the for-profit sector was significantly less likely than all sectors to experience unfair treatment in the workplace. Finally, regarding the specific discipline of employment (engineering, math and statistics, administration, and other), those working in math and statistics frequently reported significantly more positive experiences in regard to diversity and inclusion issues, especially compared to those in engineering.

Broadly speaking, results from this study highlight both areas that are encouraging and areas that require further consideration. They highlight crucial considerations regarding the satisfaction and retention of talented women, racial/ethnic minorities, persons with disabilities, and LGBTQ individuals in STEM, as both workplace climate and experiences of discrimination have an impact on organization members' satisfaction, and subsequent retention in STEM.

3. Suggestions for Moving Forward

The results reviewed above point to three key areas of intervention that the organization should consider:

1.

Women and racial/ethnic minorities report persistently more negative experiences compared to men and white respondents. Feelings of marginalization and experiences of exclusion are significantly more common among these populations than among white men. The organization should consider ways it can help foster inclusion for women and people of color, as well as fostering open dialog about the ways that the STEM expertise of women and people of color are undermined in members' workplaces.

2.

Disability status was a significant factor in a number of the marginalization and devaluation measures. Disability status is only very rarely considered and discussed within the context of STEM-related professional organizations. However, over 15% of members of this organization report some kind of disability or difficulty, whether physical or mental. The organization should consider programming and initiatives that allow persons with disabilities to articulate the ways in which the organization could better support them and promote their interests.

3.

Respondents in university settings reported instances of differential treatment and bias toward disadvantaged groups significantly more frequently than respondents in other employment settings. This suggests the need to explore departmental and institution-level factors that promote these patterns of bias at the local level. This differential also provides the opportunity for organization members from different employment sectors to learn from one another. For example, what tactics do members employed in for-profit sectors use to foster inclusiveness at the local level that may be able to be imported into the university setting?

Recommendations

Given the unique entity of the professional organization and its reach, our recommendations for STEM diversity and inclusion initiatives within INFORMS may also be applicable for INFORMS members to utilize within their own organizations.

Our recommendations for INFORMS include:

- Regular dialog with constituencies of disadvantaged groups (e.g., through focus groups, committees, and panels) to identify ongoing issues and ways the organization could provide support through programming, networking, and policy change.
- Regular ‘climate surveys’ measuring factors such as marginalization, inclusion and professional (de)valuation.
- Increase the number of INFORMS employees and leadership who are women, disabled, LGBTQ, and people of color—in all categories, from administrative to professional.
- Increase the proportion of women, people of color, and disabled and LGBTQ persons among the INFORMS membership.
- Recommend dual/multi membership and other partnerships with minority-centered STEM and operations and management-centered professional organizations.
- Integrate diversity and inclusion programming into current conferences (e.g, a seminar on microaggressions in hiring and the interview process; adding an implicit bias workshop into a leadership/management training).
- Create and continue programming at INFORMS conferences regarding disability etiquette, hidden illnesses, work habits, and accommodations testing.
- Share the events and materials of minority and women centered STEM and management professional organizations in regular INFORMS announcements or newsletters.
- Create targeted research funds or scholarships for the advancement of women, disabled individuals, LGBTQ individuals, and people of color in INFORMS-related disciplines.
- Ensure that the diversity represented in the organization is reflected in the choice of keynote and plenary speakers at regional and national conferences.
- Spotlight individuals in INFORMS (e.g., a website feature) who are engaged with other infinity groups and/or who are addressing issues of marginalization and exclusion within the field.

- Ensure all organization websites and emails are fully ADA compliant and compatible with accessibility plug-ins.
- Video-record and close-caption significant keynote addresses at INFORMS conferences and make them available online for those who are unable to attend.
- Create a specific, highlighted segment of the INFORMS website dedicated to diversity, equity, and inclusion, accessible from the homepage.
 - Consider adding information, Q&As, and resources regarding disability etiquette, gender identity etiquette, and so forth, accessible to all who visit the INFORMS website.
 - Consider featuring articles, stories, research, and interviews regarding the underrepresentation of women and people of color in operations research, management science, and analytics.
- Make the “Women in OR/MS” INFORMS subpage accessible from the homepage.
- Expand on INFORMS DEI initiatives on the Diversity, Equity, and Inclusion Committee website page.
- Share and publicize explicit INFORMS diversity goals in media to increase visibility and accountability.
- Develop a diversity, equity, and inclusion (DEI) ‘seed fund’ for INFORMS members to establish DEI initiatives in their workplace.
- Collaborate with a diversity-centered consulting firm to receive further recommendations, learn hiring practices to combat inequity, and create other methods of increasing membership diversity.
- Create a diversity & inclusion specialist role (different from a Human Resources Generalist role) in the organization to provide support and further recommendations for ongoing diversity and inclusion efforts.

Note that the findings here are reported along a single axes of inequality, and cannot reveal all patterns of marginalization that may pertain to groups experiencing multiple forms of marginalization simultaneously. Further work in the STEM Inclusion Study that aggregates survey responses from multiple professional associations will provide further analysis on these intersections.

This organization’s participation in the STEM Inclusion Study is an important signal of its willingness to consider and confront diversity and inclusion issues among its membership. Inequality in STEM is an intractable problem that has no silver bullet solution. It will take deliberate and sustained effort to help move the needle in this and other STEM-related professional organizations.

METHODOLOGICAL APPENDIX

Inclusion and Marginalization Questions	
<i>(a) Insensitive Comments</i>	I have read, heard and/or seen insensitive comments in my workplace that I found offensive. (mean = 2.44)
<i>(b) I Fit In</i>	Overall, I feel I 'fit in' with the other people in my workplace. (mean = 3.92)
<i>(c) Noticeable Mistakes</i>	I worry that my mistakes are more noticeable than the mistakes of others. (mean = 2.78)
<i>(d) Chilly Climate</i>	How often does the following happen at work: (1) A co-worker makes a negative comment or joke about women, (2) A co-worker makes a negative comment or joke about racial/ethnic minorities, (3) A co-worker makes a negative comment or joke about LGBTQ people, (4) A co-worker makes a negative comment or joke about people with disabilities. (mean = 1.29)
<i>(e) Harassed</i>	In the last 12 months, I was harassed verbally or in writing on the job. (mean = 1.28)
Professional (De)valuation Questions	
<i>(a) Same Standard</i>	I am held to the same standard as others for promotion or advancement. (mean = 3.89)
<i>(b) Less Credit</i>	My boss gives me less credit than I deserve. (mean = 2.36)
<i>(c) Work Harder</i>	I have to work harder than my colleagues to be perceived as a legitimate professional. (mean = 2.63)
<i>(d) Supervisor Respect</i>	My supervisor treats me with respect. (mean = 4.27)
<i>(e) Respect Work</i>	In my workplace, my work is respected. (mean = 4.26)
Workplace Fairness Questions	
<i>(a) Women Work Harder</i>	Generally speaking, women in my workplace must work harder than men to convince colleagues of their competence. (mean = .19)
<i>(b) LGBTQ Work Harder</i>	Generally speaking, LGBTQ individuals in my workplace must work harder than non-LGBTQ individuals to convince colleagues of their competence. (mean = .047)
<i>(c) REM Work Harder</i>	Generally speaking, racial/ethnic minority individuals in my workplace must work harder than non-minority individuals to convince colleagues of their competence. (mean = .136)
<i>(d) Harassed Race</i>	Overall, in the last 3 years, have you ever observed a person or persons being treated differently in your workplace due to any of the following characteristics? Race or ethnicity. (mean = .162)
<i>(e) Harassed Gender</i>	Overall, in the last 3 years, have you ever observed a person or persons being treated differently in your workplace due to any of the following characteristics? Gender. (mean = .211)
<i>(f) Harassed LGBTQ</i>	Overall, in the last 3 years, have you ever observed a person or persons being treated differently in your workplace due to any of the following characteristics? Sexual Identity. (mean = .04)
<i>(g) Harassed Disability</i>	Overall, in the last 3 years, have you ever observed a person or persons being treated differently in your workplace due to any of the following characteristics? Disability. (mean = .03)

In the "Inclusion and Marginalization" questions, the variables *InsensitiveComments* and *Harassed* were coded on a 1-3 scale, with 1=Never, 2=At least once in the past year, and 3= At least once a month or more.

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