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# Engineering and Computer Science Faculty Members' Personal and Professional Perspectives on Diversity, Equity, and Inclusion

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# Engineering and Computer Science Faculty Members' Personal and Professional Perspectives on Diversity, Equity, and Inclusion in STEM Education


## ABSTRACT

Individuals from racially and ethnically minoritized identities, women, and persons with disabilities continue to be minoritized in STEM academic programs and in the STEM workforce. Recognizing incumbent faculty members are gatekeepers to student success, and ultimately the STEM workforce (including academia), we aim to understand how their perspectives on diversity, equity, and inclusion might influence their professional practice.

We conducted a nationwide survey of STEM faculty members and administrators using an adapted version of Pohan and Aguilar's Personal and Professional Beliefs about Diversity scales. The questions on the Pohan and Aguilar scales cover several dimensions of diversity – race, ethnicity, gender, nationality, socioeconomic status, disability, and sexual orientation; this study included results from items related to race, ethnicity, and nationality. Though these instruments account for social desirability bias, we added items from a 10-item version of the Marlowe-Crowne Social Desirability Scale to determine respondents' tendency toward social conformity and examine the extent to which responses on the beliefs scales might be impacted by those tendencies.

The research questions that guide this study are:

- What is the relationship between engineering and computer science faculty members' personal and professional beliefs about race, ethnicity, and nationality?
- To what extent are those beliefs influenced by social desirability bias?

We administered the survey to faculty members and administrators in all STEM disciplines, including social and behavioral sciences. Of the 334 who responded to all three sections (personal beliefs, professional beliefs, and social desirability), 84 had primary appointments in engineering or computer science, and thus, comprised this study population. We found a moderate positive correlation between respondents' personal and professional beliefs. We did not find a significant relationship between personal or professional belief scores and tendency toward social conformity; however, our results indicated respondents were more favorably disposed toward personal beliefs about race, ethnicity, and nationality than professional beliefs and the relative frequency of those responses occurred in the presence of high social conformity.


## INTRODUCTION

STEM educators' beliefs about diversity have never existed within a vacuum; however, in recent years, these beliefs have become more relevant as the nation grapples with both the continued shortage of diverse talent in the STEM workforce and the simultaneous politicization of higher education. Across the U.S., diversity, equity, and inclusion (DEI)-related rhetoric is politically

charged and a growing number of states have passed or introduced bills that ban or regulate DEI initiatives in higher education institutions (Feder 2024, Chronicle of Higher Education 2024, Texas Legislature 2023). STEM educators' beliefs about diversity are important because of the historic legacy of race, class, gender, and disability inequality in the U.S., a key component of the continued exclusion of people from fully participating in the STEM workforce.

National Center for Science and Engineering Statistics (NCSES 2023) data has long shown minoritized racial and ethnic populations (Black, Latino/a/e, Native American, Native Alaskan, Native Hawaiian, and Native Pacific Islander), women, and people with disabilities' proportions in most fields in STEM have been lower than their proportions within the overall national population. Faculty members and administrators play key roles in academia, from deciding who gets hired in faculty roles to teach and advise students, to deciding policies and practices that support student retention and graduation. Thus, the beliefs of STEM faculty members and administrators about who belongs in their institutions, in their disciplines, and the types of opportunities and access they should have speak to the decision-making that shapes the exclusion that occurs in STEM.

**Purpose**

This study is part of a larger research project designed to investigate factors that help or hinder individuals from minoritized racial and ethnic identities when pursuing careers in the STEM professoriate. The research questions that guide this study are:

- What is the relationship between engineering and computer science faculty members' personal and professional beliefs about race, ethnicity, and nationality?
- To what extent are those beliefs influenced by social desirability bias?

Recognizing incumbent faculty members and administrators are gatekeepers to not only faculty hiring but also student success, and ultimately the STEM workforce, we aim to understand their perspectives on diversity, equity, and inclusion and how those perspectives might influence their professional practice.

**Measuring Attitudes toward Diversity, Equity, and Inclusion**

Diversity itself is conceptualized differently amongst people, often in contradictory ways. For example, people can often hold views about their institutions as much more diverse than they actually are (Boyd-Sinkler et al 2018). Similarly, within the context of anti-DEI legislation affecting higher education, some aspects of diversity, such as socio-economic status, are not subject to the same legal restrictions as other aspects of identity, such as race and ethnicity (Texas Legislature 2023).

Researchers have quantified respondents' diversity beliefs with key differences that focus on varying dimensions of diversity (Ng et al 2021). Pohan and Aguilar (2001) developed a dual set of scales, Personal and Professional Beliefs about Diversity Scales, to study primary and secondary educators' diversity beliefs. Their scales provide contextualization around race, gender, class, sexual orientation, disabilities, language, and religion. One scale measures

personal beliefs about diversity, including the treatment of people, relationships, stereotypes, and living conditions. The complementary scale measures professional beliefs within educational contexts like educators' treatment of students from a range of marginalized backgrounds and identities and their teaching practices. By contrast, Montei et al's (1996) Attitudes Towards Diversity Scales (ATDS) focus on prejudice in the workplaces such as attitudes toward minoritized co-workers, minoritized supervisors, and the hiring of individuals from minoritized racial groups. While some aspects may be relevant or adaptable to higher education, ATDS was based on the civil service workforce. Ng et al (2013) developed an instrument called ACES that also uses a different framework for thinking about diversity and measures factors related to attitudes, careers, environment, and social interactions among faculty members in institutions of higher education. Their aim was to understand the extent to which those factors were associated with outcomes related to their work (Ng et al 2013).

We chose the Pohan and Aguilar scales because they do not presume that people's personal and professional beliefs are congruent. For example, an educator might believe that diversity is an asset within the larger U.S. context, and they might also believe that improving the diversity of their own department or university would negatively impact its prestige (Slaton 2010). Further, while our larger project is focused on equity in STEM faculty hiring for racially and ethnically minoritized individuals, we were interested in collecting and analyzing data (for future studies) that covered several additional dimensions of diversity (e.g., disability, socioeconomic status, gender identity, and sexual orientation). Neither ATDS nor ACES is as comprehensive as the Pohan and Aguilar scales with respect to the dimensions of diversity addressed.

Data collected from attitude scales is susceptible to participants' tendency to provide responses that are in line with the prevailing beliefs within a given social arena, a phenomenon psychologists call social desirability bias (Neherdorf 1985). We added items from an abridged 10-item version of the Marlowe-Crowne Social Desirability Scale to determine respondents' tendency toward social conformity and to and examine the extent to which responses on the beliefs scales might be impacted by those tendencies. The instrument (Crowne & Marlowe 1960, Strahan & Gerbasi 1972) measures a respondent's level of concern with social desirability based on how they answer items that conform to social conventions. In this supposed "post-racial era" characterized by what Bonilla-Silva (2002) classified as color-evasiveness, it is commonplace to hear people employ language that allows for social acceptance of beliefs about others that otherwise would be deemed unacceptable; this scale allows us to account for the widespread nature of color-evasive ideology.

## METHODS

### Data Collection

***Instruments.*** During December 2023 we administered a survey to STEM faculty members and administrators throughout the U.S. The first two sections were Pohan and Aguilar's (2001) Personal Beliefs about Diversity and Professional Beliefs About Diversity scales, consisting of 15 and 25 items, respectively. The belief scales included questions that address a range of identities, including race, ethnicity, gender, disability, LGBTQ identity, socioeconomic status, and nationality. For this study, we examined only race, ethnicity, and nationality. Respondents

were asked to what extent they agreed or disagreed with each statement using a five-point Likert scale that ranged from strongly disagree (1) to strongly agree (5). To mitigate response bias, the original instruments contained some items that were worded such that the responses had to be reverse coded; we retained that wording.

The scales were developed for K-12 education; therefore, we edited some of the terms to make them applicable to higher education (e.g., faculty instead of teachers, institution instead of school). Because we were interested in STEM education, we also modified some of the language so it was specific to STEM instead of using general references. For example, an original professional beliefs item was: "Historically, education has been monocultural, reflecting only one reality and has been biased toward the dominant (European) Group" (Pohan & Aguilar 2001). We reworded it as: *Historically, STEM education has been monocultural, reflecting only one reality and has been biased toward the dominant (Western) group.* We consider these changes non-substantial, and very few were made; thus, we do not believe they impacted the efficacy of the scales.

The third section of the survey was a shortened version of the Marlow-Crowne Social Desirability Scale (M-C SDS), which was designed to provide a sense of the degree to which social conformity might impact responses (Crowne & Marlowe 1960). Specifically, we used MC-1(10) by Strahan and Gerbasi (1972), which reduced the original 33-item instrument to 10 items with lower, yet reasonable reliability compared to the longer instrument. Although social desirability was accounted for in the development and validation of the Pohan and Aguilar scales, we thought it was important to capture this data in real-time as we seek to use the scales in a STEM higher education context. Because the beliefs scales consisted of 40 items total, we used the MC-1(10) to promote higher survey completion rates than we might have obtained if we had used the full version of that instrument.

The M-C SDS uses a series of true/false questions to gauge respondents' proclivity for providing responses that are impacted by social desirability, defined by the developers as "culturally acceptable and approved behaviors which are, at the same time, relatively unlikely to occur" (Crowne & Marlowe 1960). Certain responses received a point, depending on the respondents' answers. Total scores provide an indication of low, average, or high tendency toward social conformity.

For construct validity, before launching the survey we conducted cognitive interviews with six volunteers who were STEM faculty members at two institutions. Institution 1 is a public Historically Black College/University with an R2: Doctoral University, High Research Activity Carnegie classification. Institution 2 is a public Hispanic Serving Institution with an R1: Doctoral University, Very High Research Activity Carnegie classification. Five faculty members were men, one was a woman; they held ranks at the assistant professor, associate professor, and professor levels. Departments represented were electrical engineering, civil engineering, information technology, and biotechnology. Overall, interviewees described the survey as "straightforward" and "easy to read." However, faculty members for whom English was their second language indicated that a few questions required careful reading. For example, a question using the phrase "practice what I preach" was unclear to some international faculty members; therefore, we added a parenthetical note (i.e., do as I advise others to do) for clarification. In

addition to clarifying statements like this, we underlined the word "not" in all questions to bring attention to it.

***Population.*** We used a combination of convenience sampling and purposive sampling to recruit survey participants by sending emails to principal investigators leading projects funded by the Directorates for STEM Education; Engineering; and Social, Behavioral and Economic Sciences at the National Science Foundation (NSF). We used NSF's award database to search for projects with start dates from October 1, 2021 through December 8, 2023. We also enlisted the support of the American Association for the Advancement of Science (AAAS) to share the recruitment email with their STEM educator listserv. Snowball sampling was employed to a lesser extent, given the recruitment email included a request for recipients to share the message with other STEM faculty members in their networks.

The survey began with screening items, which ensured we included only respondents in populations of interest. These were tenure system and non-tenure system faculty members and administrators in all STEM disciplines, including social and behavioral sciences, as well as discipline-based STEM education (e.g., engineering education or science education). We excluded non-tenure system faculty members holding research appointments (e.g., research professors, research scientists) and faculty members in clinical disciplines (e.g., nursing, medicine).

We received 427 valid responses to the survey (i.e., those who responded to the screening items, at a minimum). Of those, 332 completed all three sections of the survey. A total of 84 of this subset of responses were from faculty members and administrators whose primary appointments were in engineering (n=65) or computer science (n=19). We did not include discipline-based education in our sample for this study because we were not able to disaggregate by education discipline (i.e., distinguish engineering education from other areas of STEM education).

Tables 1 and 2 summarize the institutional and personal demographics of the respondents, respectively, for informational purposes; analysis by demographic groups is beyond the scope of this study. Only 65 of the 84 engineering and computer science respondents provided information about their current institutions; of those, 17 (26.2%) were from Minority Serving Institutions (MSIs).

**Table 1. Institutional Demographics of Survey Respondents**

| **Basic Carnegie Classification (N=65)** | **Number** | **Percent** |
|---|---|---|
| Doctoral Institutions | 55 | 84.6 |
| Master's Universities | 6 | 9. 2 |
| Bachelor's Institutions | 1 | 1.5 |
| Associate's Colleges | 3 | 4.6 |
| **Minority-Serving Institution Status (N=17)** | **Number** | **Percent** |
| Alaska Native-Serving Institution (ANSI) or Native Hawaiian-Serving Institution (NHSI) | 1 | 5.9 |
| Asian American and Native American Pacific Islander-Serving Institution (AANAPISI) | 2 | 11.8 |
| Hispanic Serving Institutions (HSI) | 6 | 35.3 |
| HSI+AANAPISI | 4 | 23.5 |
| Historically Black Colleges and Universities (HBCU) or Predominantly Black Institutions (PBI) | 4 | 23.5 |

**Table 2. Personal Demographics of Survey Respondents**

| **Age Range (N=84)** | **Number** | **Percent** |
|---|---|---|
| Under 50 | 54 | 64.3 |
| 50-69 | 25 | 29.8 |
| 70 and Over | 2 | 2.4 |
| Prefer Not to Answer | 3 | 3.6 |
| **Gender (N=84)** | **Number** | **Percent** |
| Man | 40 | 47.6 |
| Woman | 40 | 47.6 |
| Transgender, Non-binary, and/or Another Gender | 1 | 1.2 |
| Prefer Not to Respond | 3 | 3.6 |
| **Race and Ethnicity (N=84)** | **Number** | **Percent** |
| Asian or Asian American | 10 | 11.9 |
| Black or African American | 6 | 7.1 |
| Hispanic or Latino/a/e | 4 | 4.8 |
| Middle Eastern or Northern African | 3 | 3.6 |
| Native American or Alaska Native | 0 | 0.0 |
| Native Hawaiian or Native Pacific Islander | 0 | 0.0 |
| White | 42 | 50.0 |
| A race and/or ethnicity not listed here | 2 | 2.4 |
| More than One Race/Ethnicity | 12 | 14.3 |
| I prefer not to answer | 5 | 6.0 |

## Data Analysis

Beginning with the dataset that represented our engineering and computer science respondents (n=84), we extracted personal and professional beliefs items related to race, ethnicity, nationality, and language, as well as those we considered general (Table 3). After recoding some items as reflected in Table 1, we used Cronbach's alpha to examine the internal consistency and Spearman's correlation coefficient to determine if there was a relationship between respondents' personal and professional beliefs.

We converted the average beliefs scale responses to favorability scores (favorable [4,5], neutral [3], and unfavorable [1,2]) in each category and converted MC-SDS scores to categorical data reflecting low (0-2), average (3-6), and high (7-10) tendencies toward social conformity. We examined correlations between responses on each of the beliefs scales and the MC-1(10) using Spearman's correlation coefficient and used the Kruskal-Wallis test to compare the personal and the professional beliefs of the three groups – those with low, average, and high tendency toward social conformity – to determine if differences occurred due to social desirability.

## RESULTS AND DISCUSSION

Before analyzing the data, we removed two responses that had blank items to ensure we had matched pairs for the correlation analyses and that the blank responses would not skew results. To determine reliability, we computed the totals of the responses on each scale – personal beliefs and professional beliefs – then calculated Cronbach's alpha to measure the level of internal consistency within each scale. Similar to Pohan and Aguilar (2021), the professional beliefs scale yielded stronger internal consistency ($\alpha$=0.83) than the personal beliefs scale items ($\alpha$=0.59), which can be partially explained by the number of items in each scale, as fewer items generally

produce lower alphas (Pohan & Aguilar 2001). For this study, we used the six personal beliefs scale sub-items and 12 professional beliefs sub-items. Further, alphas tend to be lower on instruments that measure attitudes as compared to those designed to measure other constructs (Taber 2017, Pohan & Aguilar 2001). Thus, our results indicate a satisfactory level of reliability for this study.

**Table 3. Survey Items by Scale**

| **Personal Beliefs Items** |
|---|
| There is nothing wrong with people from different racial backgrounds having/raising children. |
| People should develop meaningful friendships with others from different racial/ethnic groups. |
| In general, White people place a higher value on education than do people of color. (R) |
| America's immigrant and refugee policy has led to the deterioration of America. (R) |
| It is more important for immigrants to learn English than to maintain their first language. (R) |
| Accepting many different ways of life in America will strengthen us as a nation. |
| **Professional Beliefs Items** |
| Only institutions serving students of color need a racially, ethnically, and culturally diverse faculty and staff. (R) |
| People of color are adequately represented in most textbooks today. (R) |
| Students who grew up in racially isolated neighborhoods can benefit socially from participating in racially integrated classrooms. |
| Multicultural education is most beneficial for students of color. (R) |
| Large numbers of students of color are improperly placed in remedial courses (e.g., mathematics) by university personnel. |
| In order to be effective with all students, faculty should have experience working with students from diverse racial and ethnic backgrounds. |
| Multicultural education is less important than English, writing, mathematics, and computer science. (R) |
| All students should be encouraged to become fluent in a second language. |
| Historically, STEM education has been monocultural, reflecting only one reality and has been biased toward the dominant (Western) group. |
| Students should not be allowed to speak a language other than English while in class. (R) |
| Whenever possible, second language learners should receive instruction in their first language until they are proficient enough to learn via English instruction. |
| Faculty should not be expected to adjust their preferred mode of instruction to accommodate the needs of all students. (R) |

R = Item was reverse coded

## Relationship between Personal and Professional Beliefs

The ranges of possible total scores were 6 to 30 on the personal beliefs scale and 12 to 60 on the professional beliefs scale, with higher scores indicating more favorable disposition toward diversity, equity, and inclusion pertaining to race, ethnicity, and nationality. We plotted the totals to visually observe the relationship between the variables and found a positive, monotonic relationship (Figure 1). We calculated Spearman's correlation coefficient using the ranks of the totals and found a moderate positive correlation between the variables ($r_s$=0.59). Most respondents had a favorable disposition to diversity, equity and inclusion, on both the personal and professional scales.

Items that scored least favorably (i.e., average scores less than 3.5 on the scales are summarized in Table 4. The table shows that faculty hold less favorable personal and professional beliefs about linguistic differences; this may infer that respondents place English learning as a priority in and outside the classroom. The table also shows that faculty hold less favorable professional

beliefs towards multicultural education; one can infer that faculty respondents do not consider multiculturalism, including multilingualism, to be an essential part of STEM education. Similarly, faculty may reject the notion that remedial courses are connected to larger structural inequities that disproportionately impact students of color and instead reproduce deficit thinking about groups that have been historically excluded from STEM.

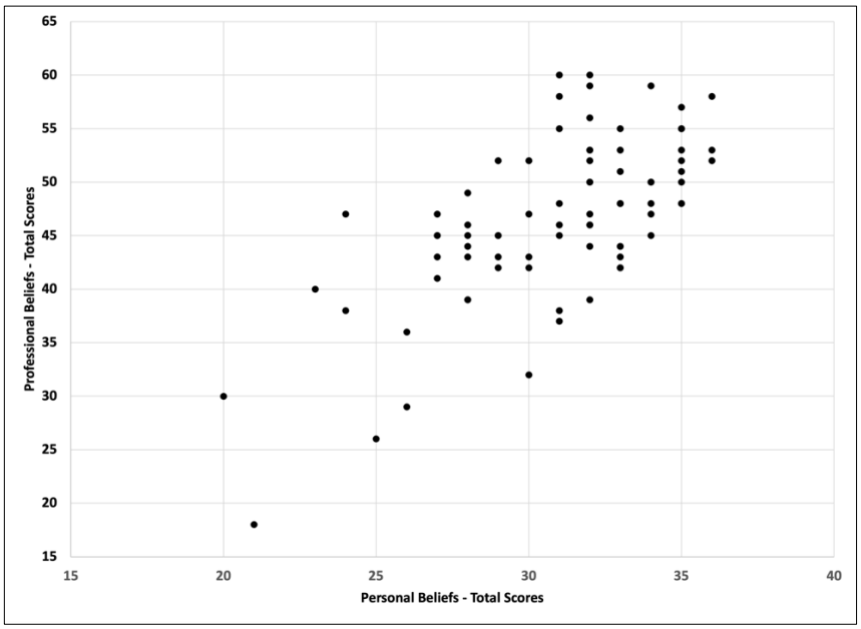


**Figure 1. Professional vs Personal Belief Response Totals (N=82)**

**Table 4. Descriptive Statistics for Least Favorable Personal and Professional Beliefs Items Related to Race, Ethnicity, and Nationality**

| Item | Mean | Std. Dev. | Min | Max |
|---|---|---|---|---|
| **Personal Beliefs Scale** | | | | |
| It is more important for immigrants to learn English than to maintain their first language. (R) | 3.2 | 1.16 | 1 | 5 |
| **Professional Beliefs Scale** | | | | |
| Whenever possible, second language learners should receive instruction in their first language until they are proficient enough to learn via English instruction. | 3.2 | 1.21 | 1 | 5 |
| Large numbers of students of color are improperly placed in remedial courses (e.g., mathematics) by university personnel. | 3.1 | 1.09 | 1 | 5 |
| Multicultural education is less important than English, writing, mathematics, and computer science. (R) | 3.4 | 1.22 | 1 | 5 |

## Influence of Social Desirability Bias

Survey responses indicated just over one third of participants (34%) had high tendency toward social conformity and most (56%) had average tendency, though the distributions were different for the personal and professional beliefs scales (Figures 2 and 3). Notably, respondents were nearly twice as likely to respond favorably to personal beliefs items compared to professional beliefs items (79.3% versus 47.6%) and more than twice as likely to have neutral responses to professional beliefs items compared to personal beliefs items (45.1% versus 17.1%). They were

also twice as likely to respond unfavorably to professional beliefs items than to personal beliefs items (7.3% versus 3.7%), though the number was small (six and three respondents, respectively), and thus, we are careful with our interpretation. The results indicate respondents are more favorably disposed toward personal beliefs about race, ethnicity, and national origin than they are professional beliefs. However, roughly a quarter (24.4%) of favorable personal belief responses occurred when high social desirability was present (compared to 15.9% for professional beliefs). One can infer that there is less social pressure in the academic environment for faculty members to have favorable beliefs toward diversity which, interestingly, is contradictory to how anti-DEI legislators characterize university environments.

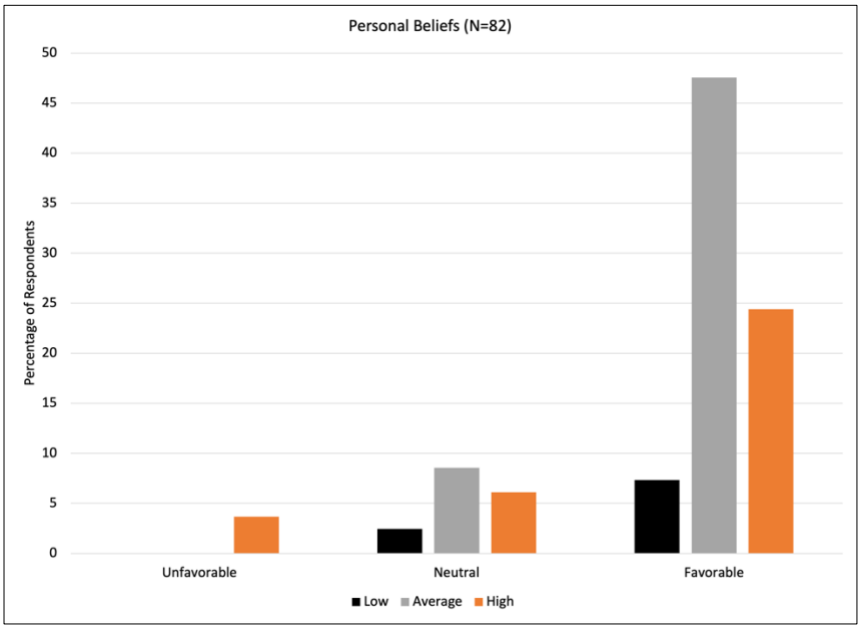


**Figure 2. Personal Beliefs versus Social Conformity**

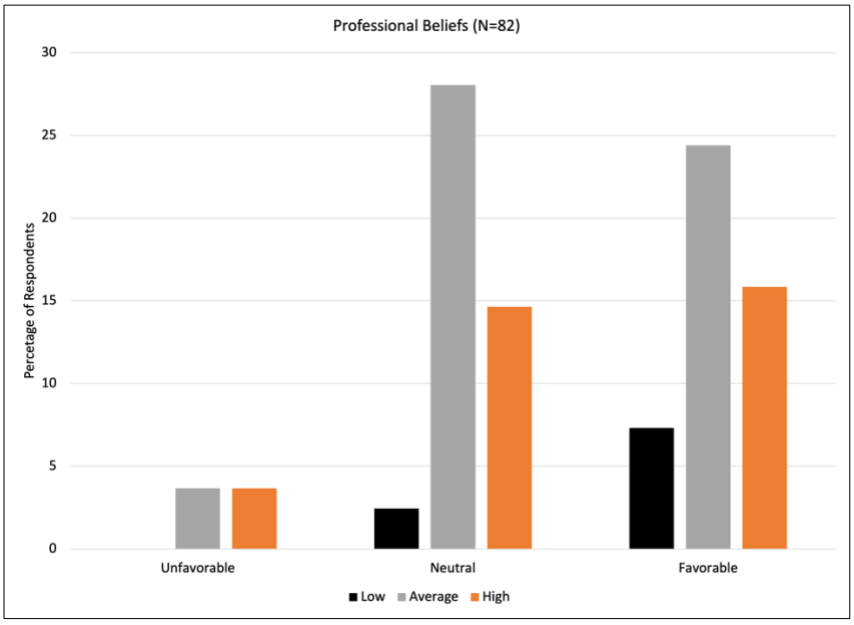


**Figure 3. Professional Beliefs versus Social Conformity**

Institutional culture plays an important role in shaping professional beliefs concerning race, ethnicity and nationality; desire to conform to institutional norms can lead to practices that inhibit the full inclusion of marginalized students in STEM. Prevailing institutional practices – such as creating remedial courses that can gatekeep entry into STEM – may appear neutral but exacerbate inequities; faculty members' desire for social conformity – and its accompanying rewards such as tenure and promotion – may in turn reinforce conditions that prevent the full inclusion of marginalized students.

We performed Kruskal-Wallis tests to determine if there were differences in respondents' personal or professional beliefs associated with their tendency toward social conformity. Our results indicated that there was no significant difference in mean personal or professional beliefs scores across the three groups (low, average, and high tendency toward social conformity). Results are summarized in Table 5.

**Table 5. Kruskal-Wallis Test Results (N=82, df=2, $\alpha$=0.05)**

| | Personal Beliefs | Professional Beliefs |
|---|---|---|
| Kruskal-Wallis Statistic, H | 2.92 | 1.91 |
| Mean Rank Low Group ($n_{low}$=8) | 54.9 | 51.9 |
| Mean Rank Average Group ($n_{avg}$ = 46) | 40.7 | 41.4 |
| Mean Rank High Group ($n_{high}$ = 28) | 38.9 | 38.8 |

## CONCLUSION

We administered a nationwide survey to gauge STEM faculty members' and administrators' personal and professional beliefs about diversity and to examine the extent to which those beliefs were impacted by social desirability bias. The beliefs items were Pohan and Aguilar's (2001) Personal and Professional Beliefs about Diversity scales with non-substantial adaptations to make the instrument, which was designed for K-12 education, relevant to STEM higher education. Tendencies toward social conformity were measured using a 10-item version of the Marlowe-Crowne Social Desirability Scale (Crowne & Marlowe 1960, Strahan& Gerbasi 1972).

Our analyses showed a moderate, positive correlation between respondents' personal and professional beliefs about race, ethnicity, and nationality, indicating higher scores on the professional beliefs scales were generally associated with higher scores on the personal beliefs scales. Though we found no significant relationship between personal or professional belief scores and tendency toward social conformity, our results indicated respondents were more favorably disposed toward personal beliefs about race, ethnicity, and nationality than toward professional beliefs and that favorable responses on the personal beliefs scale were 1.5 times more likely to be associated with high tendencies toward social conformity than those on the professional beliefs scale.

### Limitations

The original personal and professional beliefs scales measure beliefs across several dimensions of diversity – race, ethnicity, nationality, gender, sexual orientation, disability, socioeconomic status; our study focused only on the first three categories. We acknowledge the original authors' intent for all items to be used summatively rather than separated based on identity group;

however, given the age of the instrument and the differences we observe in practice – and in society – that favor diversity along some dimensions while opposing it along others, we thought it was important to examine results by group.

### Implications and Future Research

Understanding STEM faculty members' and administrators' personal and professional beliefs about diversity can help academic leaders better understand their institution's culture and climate so they can identify and mitigate barriers to success for marginalized groups. This, in turn, can impact the STEM workforce; by creating conditions that support the persistence of historically excluded groups in STEM, campus leaders can begin to ameliorate the dearth of diversity in the field. In the longer term, this can reduce the societal inequities that result from the lack of diverse, equitable, and inclusive STEM practitioners.

We are analyzing our larger data set to explore whether there are differences between engineering and computer science faculty members and their peers in social and behavioral sciences. We are also examining whether respondents' perspectives on diversity, equity, and inclusion are associated with exposure to different institutional contexts.

Further research is needed to understand how – or if – personal and professional beliefs and behaviors shift in relation to social conformity. This will be especially important if the anti-DEI climate in the U.S. continues to grow. In particular, we question whether we will start to see higher social conformity associated with unfavorable dispositions toward diversity, equity, and inclusion. Additional research could also explore how faculty members' and administrators' beliefs translate to behaviors, standardized practices, and policies (positive and negative), and thereby, the climate for STEM students, staff, and faculty members from marginalized identities.

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