A Quantitative Analysis of Engineering Identity and Sense of Belonging for Students Who Provide Derogatory Responses to Write-in Demographic Questions

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Abstract

This full empirical research paper explores engineering identity and sense of belonging among participants who use write-in demographic options on surveys to give derogatory or otherwise negative responses. Traditionally, these derogatory responses are considered a "norm" of research, removed during data cleaning, and are thus rarely the focus of a study. This investigation specifically investigates these participants' sense of belonging (sense of fitting in within engineering) and engineering identity (sense of being the kind of person who does engineering). These constructs may help us understand who these participants are within engineering and why they might behave this way. By combining four surveys from large NSF-funded projects into a single dataset, we created a dataset comprising n=9,904 undergraduate engineering students, of whom n= 127 left derogatory responses. All write-in responses in the race/ethnicity, gender, and sexual orientation categories were identified and manually classified as either non-derogatory or derogatory. Derogatory responses occurred across all demographic categories, though most frequently in the gender category. After identifying derogatory responses, we used structural equation modeling to analyze (in)direct effects and latent relationships with engineering identity and belonging. We found that those in the derogatory group had lower perceptions of performance/competence, interest, recognition, identity, and sense of belonging in engineering. Drawing upon existing literature, we connect this behavior to the experiences of marginalized students, who describe being discriminated against by their peers. We question how deeply ingrained bigoted behavior is in engineering culture and call on all members of the engineering community to drive a culture shift that makes diversity and inclusion central in engineering.

Introduction

Write-in demographic options are provided on surveys to be inclusive of students who do not feel they are represented in the options provided [1, 2]. These options allow participants to specify exactly how they would like to be represented according to race/ethnicity, gender, sexual orientation, socioeconomic status, disability status, or another form of social identity. However, researchers are aware that the write-in option is sometimes used in a derogatory manner. Receiving responses such as "attack helicopter" or other derogatory remarks about various social identities is an unfortunate norm in data collection. These responses are often removed during data cleaning, leaving very little known about this population and why they engage in this type of activity. This paper examines this specific population by investigating their engineering identity and sense of belonging within engineering. We answer the following research questions (RQs):

RQ1: What types of derogatory responses do undergraduate engineering students provide?

RQ2: How does engineering identity and sense of belonging differ, if at all, for students who provide derogatory responses to demographic questions when compared to those who do not?

This paper is exploratory in nature, seeking to determine if statistically significant differences in engineering identity and sense of belonging exist for students who provide derogatory write-ins compared to those who provide no write-in response or a non-derogatory response. We aim to open the door to further research and understanding of this population.

Background/Theoretical Framework

Identity can be described as the "kind of person" one sees oneself as [3]. In engineering, it is the sense of seeing oneself as an engineer [4]. Stemming from science professional identity [5], engineering role identity is comprised of three dimensions: performance/competence in

engineering tasks, interest in engineering, and recognition as an engineer from meaningful others [4]. These dimensions are interrelated and predictive of engineering identity, which itself predicts sense of belonging [6, 7]. Current literature indicates that students who develop a stronger engineering identity are more likely to complete their degrees and enter the workforce [8], while those who do not may experience isolation from their peers [9], resulting in a departure from engineering [10]. Using engineering identity and sense of belonging to explore the experiences of participants who leave derogatory comments may help us understand how they view themselves in relation to peers in engineering, and why they engage in derogatory expression to begin with.

Methods

This project uses multiple datasets to compile a pool of n=30 universities across the United States, yielding a sample of n=9,904 undergraduate engineering students. As we described in a prior, relevant paper, which investigated LGBTIQA+ students' engineering identity and sense of belonging [11], we collected data from four other projects: a 2016 study on identity in engineering student attitudes [12], a 2018 study on student success [13], a 2019 study of latent diversity [14], and a 2023 study on teamwork [15]. These surveys included the same measures of sense of belonging (12 items; α=0.89 [4]) and engineering identity (6 items; α=0.77 for recognition, 0.89 for interest, and 0.88 for performance/competence [3]), as presented in Appendix A.

Demographic Data Management

The demographic data provided by students required several adjustments to ensure consistency across all surveys involved. This need arises because each survey offered different options as the language surrounding identities has evolved. In the race/ethnicity sections, the options "Biracial" and "International" had to be dropped entirely, as they could not be combined with other groups. We assumed (a limitation) that participants who selected these options selected additional demographic options, so we did not modify their demographic information. In the gender category, the male/female options were combined with their respective man/woman categories to create consistent language that refers to gender instead of biological sex. Another modified option was the "Nonbinary" option, which was available in only one survey; we added it to the "Agender" group. In this category, a few combined groups were created to examine differences between individual and grouped identities. An overall transgender and gender non-conforming (TGNC) group was created and called "TGNC," which grouped those who identified as transgender, agender/nonbinary, and/or genderqueer. In the sexual orientation category, there was a modification to "Pansexual", which we combined with "Bisexual." Additionally, a group called "Queer Sexuality" was created to include participants who identify as anything other than straight, and a group called "LGBTQIA+" was created to encompass all Queer identities in the sample.

To ensure that every participant was represented to the best of the researchers' ability, write-in responses were reviewed by the first and second authors, and participants were manually assigned to the closest approximate group that represented their identity. From the total n=9,904 participants, we found that n=289 (2.9%) participants submitted a write-in response that contained a mixture of valid responses and erroneous or derogatory responses (henceforth referred to as just derogatory). Derogatory responses were identified using a process we describe further (refer to Qualitative Coding) and included responses such as "Attack Helicopter," "pot," and "dont [sic] matter." Of the n=289 total write-in participants, n=127 (43.9%) submitted derogatory responses, and these profiles were manually tagged for analysis. Table 1 provides demographic information

for the overall sample and the derogatory sample, including write-in responses. Demographic questions were "mark all that apply," so totals may exceed 100%. Missing Data represents participants who had no information regarding the respective demographic category.

Table 1. Demographics of the sample, including write-ins

	n	Overall %	Derogatory n	Derogatory %
Race/Ethnicity				
Native American	142	1.4	4	3.1
Asian	1310	13.2	13	10.2
Black or African American	465	4.7	7	5.4
Hispanic, Latino, or Spanish Origin	1296	13.1	14	10.9
Middle Eastern or North African	190	1.9	2	1.6
White	6066	61.3	55	43.3
Native Hawaiian or Other Pacific Islander	90	0.9	2	1.6
Missing Data	1259	12.7	47	37
Gender				
Man	6366	64.3	51	39.5
Cisgender Man	199	2	2	1.6
Transgender Man	12	0.1	0	0
Woman	2298	23.2	7	5.5
Cisgender Woman	129	1.3	0	0
Transgender Woman	4	0	0	0
TGNC	57	0.6	1	0.8
Transgender	22	0.2	0	0
Agender	22	0.2	1	0.8
Genderqueer	27	0.3	0	0
Missing Data	1214	12.3	68	53.5
Sexual Orientation				
Straight	8139	82.2	72	56.7
Queer Sexuality	542	5.5	4	3.1
Lesbian or Gay	133	1.3	1	0.8
Bisexual	337	3.4	1	0.8
Asexual	87	0.9	2	1.6
LGBTQ+	555	5.6	4	3.1
Missing Data	1267	12.8	52	40.9

Qualitative Coding

The demographic information for participants who provided write-in responses was collected and organized by race/ethnicity, gender, and sexual orientation. The first round of coding was guided by the question: "Does this response *disregard, mock, or attack* social identities or research into social identities?" This question was developed and coded collaboratively by the first and second authors to determine who counted as writing a derogatory comment (i.e., was part of the derogatory group). Among derogatory responses, we noticed a group that seemed more severe than others. As such, a secondary round of coding of the derogatory comments took place using an additional guiding question: "Does this response directly contribute to the erasure of marginalized people or their experiences?" This group was termed "Alt-Write" due to clear intentions to attack or erase the experiences of marginalized people, similarly to intentions seen in Alt-Right movements [16, 17]. We borrowed this term from Dr. Adam Kirn (personal conversation), who considered developing a related project based on the demographic responses observed in a data subset and shared the term with the authors [18]. When it was unclear to which group the response belonged, we deferred to the less severe group. All participants who fit the derogatory and Alt-Write

questions were manually marked to create comparable groups, and participants were added to the group based on the most severe response they had (e.g., a participant with both a derogatory response and an Alt-Write response was added to Alt-Write).

Positionality

The positionality of the first and second authors who coded the write-in responses is important to consider. The first author identifies as a White, agender, queer person with a chronic illness and has experience in LGBTQIA+ advocacy in engineering. The second author identifies as a White non-binary person with multiple chronic illnesses and previous experience of poverty. Both authors use critical frameworks to support marginalized populations through their research and recognize that their experiences and perceptions influenced how the responses were coded. We provided all write-in responses in Appendix B to promote transparency and counter this limitation, though it does not fully remove it. We encourage the research community at large to contribute their viewpoints, either through conversation about the results presented here or through an investigation in their own datasets, to develop a more robust understanding of what a derogatory and Alt-Write response is for the research community.

Structural Equation Modeling

After the profiles were manually sorted and tagged, we employed structural equation modeling (SEM) to investigate how the groups' engineering identities and sense of belonging differed, while controlling for various demographic factors. SEM allows researchers to simultaneously explore latent constructs and relationships among multiple constructs [19]. Using R and the package *lavaan* [20,21], we built and tested the SEM model; a Weighted Least Squares Robust Means Variance (WLSMV) estimator was used to account for the large number of binary or ordinal variables [22]. The fit of the model was determined using the following best practice statistical measures: a Comparative Fit Index (CFI)>0.95, a Tucker-Lewis Index (TLI) or Non-Normed Fit Index (NNFI)>0.95, a Root Mean Square Error of Approximation (RMSEA)<0.08 with an upper tail<0.06, and a Standard Root Mean Square Residual (SRMR)<0.08 [23].

The model underwent several rounds of revision. It was first tested with no demographic variables and low-loading items, based on Squared Standardized Loadings (SSLs) <0.4, which were trimmed from the model. Then the derogatory variable was added and tested for significance (p<0.05). Finally, the demographic variables were added, trimmed, and tested for significance using p<0.05 for majority groups and p<0.1 for minoritized groups as a part of a feminist sociological practice described by Mize [24]. This practice is used to account for small sample sizes of marginalized groups and prevent the possible quantitative erasure of their experiences. As such, we were willing to accept the higher possibility of a Type I error to understand their experiences. Once all non-significant variables were trimmed, the statistical measures for fit were rechecked, and the total effects and effect sizes (Cohen's d) were calculated. We used the following cutoffs: small effect d<0.30, between d=0.30 and d=0.70 for medium effects, and d>0.70 for large effects [25]. Both the (in)direct effects and total effects are detailed in our results, but only the total effects with the accompanying effect sizes are used to evaluate our research questions.

Results

Write-in Responses

Across the n=289 participants who provided a written-in response, there were n=375 write-in

responses across race/ethnicity, gender, and sexual orientation. Overall, most write-in responses were in the race/ethnicity category (n=158), followed by sexual orientation (n=119) and gender (n=98). Of these responses, n=187 responses (50%) were identified as derogatory (n=165) or Alt-Write (n=22) coming from n=127 participants. The derogatory group comprises of participants from all four surveys, with n=9 from the 2016 survey [12] (7.1% of derogatory group, 0.26% of survey participants), n=24 from the 2018 survey [13] (18.9% of derogatory group, 1.1% of survey participants), n=92 from the 2019 survey [14] (72.4% of derogatory group, 2.5% of survey participants), and n=3 from the 2023 survey [15] (2.4% of derogatory group, 0.50% of survey participants). A disproportionate number of participants came from the 2019 study on diversity, suggesting that either the study's timing or its topic may have contributed to the rate of derogatory responses. Furthermore, this survey is the only one in which more participants provided derogatory write-in responses than recognized write-in responses, with almost twice as many derogatory participants (n=92) as recognized write-in participants (n=48). All Write-in responses are provided in Appendix B, where they have been sorted into the respective categories and are not edited or censored. ***Content Warning:*** **There is significant queerphobic language used that may be distressing.** We encourage readers to review the included responses to understand the severity of the issue we are exploring; however, we recognize that viewing these responses may be difficult for many. Moving forward, this paper will quote the write-in responses only minimally to make results physically and emotionally accessible to as many readers as possible.

Looking at all the derogatory responses, there is a wide range, including references to items, animals, memes, and other people. There are very few clear themes from the responses, save for frequent queerphobic rhetoric, addressing RQ1. Most of the derogatory responses were in the gender category (n=86, 88% of the gender responses), followed by sexual orientation (n=54, 45% of the sexual orientation responses), and then race/ethnicity (n=47, 28% of the race/ethnicity responses). The derogatory responses in the gender category were so extensive that the number one write-in response for gender was “attack helicopter” (n=35), followed by references to items/animals (n=19). *Notably, there are more participants who left derogatory responses in the gender category than there are TGNC participants in the dataset, and more participants who wrote “attack helicopter” in gender than any one TGNC subgroup.* Alt-Write responses were small in number (7.6% of the write-in responses, 12% of the derogatory responses), which may stem from a conservative application of the term to align with our guiding coding question, and either directly attacked LGBTQIA+ identities or indicated that social identities did not affect their experience.

Model Fit

The base model [6, 7] was first confirmed, and low-loading items were trimmed. Initial fit indices were as follows: Robust CFI=0.983, Robust TLI=0.980, Robust RMSEA=0.057, Robust RMSEA upper tail=0.058, SRMR=0.063. The initial model met standards for good fit, so we proceeded to control for demographics. After low-significance demographic variables were removed, the indices of good fit were: Robust CFI=0.936, Robust TLI=0.928, Robust RMSEA=0.068, Robust RMSEA upper tail=0.069, SRMR=0.090. The final model met standards for acceptable/good fit. In the final model, we found performance/competence had a medium positive relationship with recognition (β=0.77, p<0.001, d=0.64) and interest (β=0.87, p<0.001, d=0.69). Similarly, recognition (β=0.18, p<0.001, d=0.86) had a large positive relationship with engineering identity, while interest (β=0.62, p<0.001, d=0.29) had a small positive relationship. Finally, engineering identity (β=1.15, p<0.001, d=0.38) had a medium positive relationship with sense of belonging.

Direct Effects

Demographic information and whether a participant was part of the derogatory group were used to evaluate how experiences associated with participants' identities might predict their responses to each variable. Direct effects are represented in Figure 1, and total effects are listed in Table 2.

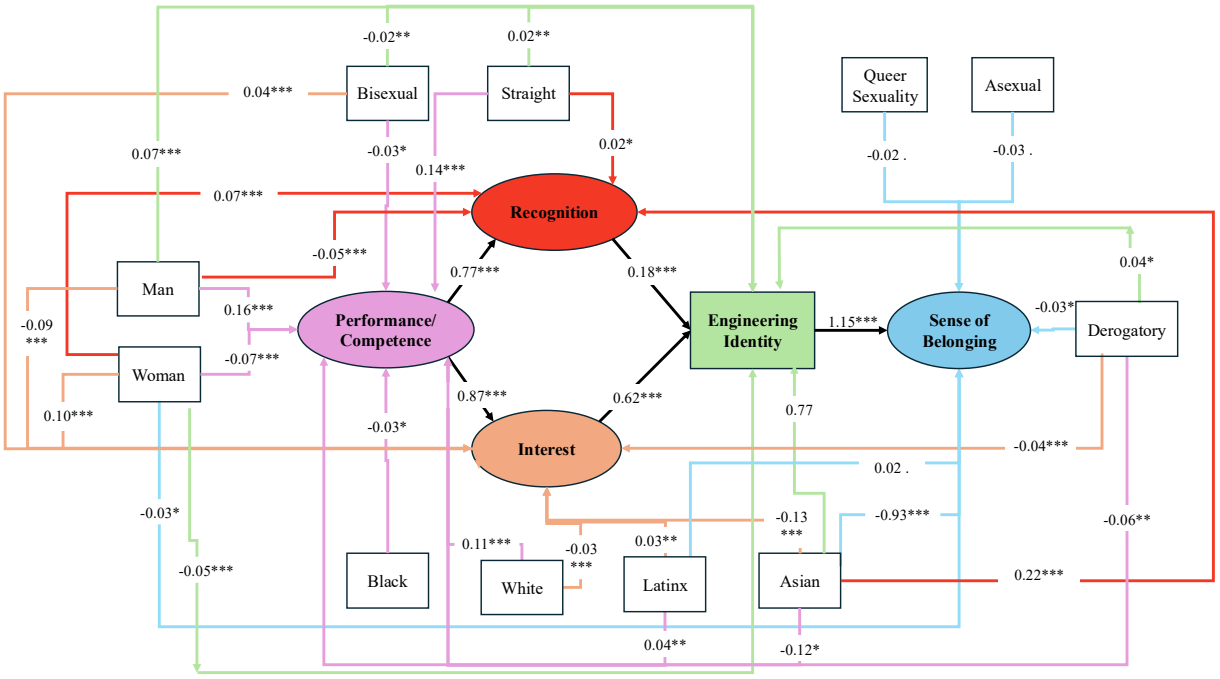

Figure 1. Summary of how individuals who identified with a specific demographic group felt a direct influence on their engineering identity and sense of belonging. The values presented are the direct effects (γ), and significance is denoted by p<.1 (.), p<.05 (*), p<.01 (**), and p<.001 (***).

We found that those who identify as Asian (γ=-0.12, p=0.024), Black (γ=-0.03, p=0.032), Latinx (γ=0.04, p=0.003), White (γ=0.11, p<0.001), bisexual (γ=-0.03, p=0.044), straight (γ=0.14, p<0.001), as a woman (γ=-0.07, p<0.001), as a man (γ=0.16, p<0.001), or those in the derogatory group (γ=-0.06, p=0.001), had varying performance/competence beliefs. Those who identified as Asian (γ=0.22, p<0.001), straight (γ=0.02, p=0.036), or as a woman (γ=0.07, p<0.001) had higher recognition beliefs. Opposingly, those who identified as men (γ=-0.05, p < 0.001) had lower recognition beliefs. Those who identified as Latinx (γ=0.03, p=0.003), bisexual (γ=0.04, p<0.001), or as women (γ=0.10, p<.001) had higher interest in engineering. Simultaneously, those identifying as Asian (γ=-0.13, p<0.001), White (γ=-0.03, p<0.001), or as men (γ=-0.09, p<0.001), and those in the derogatory group (γ=-0.04, p<0.001) had lower interest in engineering.

For engineering identity, we found those who identified as Asian (γ=0.77, p<0.001), straight (γ=0.02, p=0.010), as men (γ=0.03, p<0.001), and those a part of the derogatory group (γ=0.04, p=0.010) had higher engineering identity, while those who identified bisexual (γ=-0.02, p=0.007) or as women (γ=-0.05, p<0.001) had lower engineering identity. Finally, we found that participants who identified as Asian (γ=-0.93, p<.001), asexual (γ=-0.03, p=0.070), as a woman (γ=-0.03, p=0.028), as having Queer sexuality (γ=-0.02, p=0.085), or were a part of the derogatory group (γ=-0.03, p=0.033) had a lower sense of belonging. Only those who identified as Latinx (γ=0.02, p=.062) had a higher sense of belonging.

Table 2. The total effects on engineering identity and sense of belonging.

	Std. Est.	Std. Err.	*p*	Sig.	Cohn's *d*
Performance/Competence					
Derogatory	-0.06	0.14	0.001	**	**0.35**
Asian	-0.12	0.82	0.024	*	0.02
Bisexual	-0.03	0.08	0.046	*	0.01
Black	-0.03	0.07	0.032	*	0.13
Latinx	0.04	0.04	0.003	**	0.17
Man	0.16	0.03	0.000	***	**0.37**
Straight	0.14	0.04	0.000	***	0.20
White	0.11	0.03	0.000	***	0.15
Woman	-0.07	0.03	0.000	***	0.09
Recognition					
Performance/Competence	0.77	0.03	0.000	***	**0.64**
Derogatory	-0.04	0.16	0.001	**	0.22
Asian	0.13	1.11	0.009	**	0.00
Bisexual	-0.02	0.09	0.046	*	0.01
Black	-0.02	0.08	0.033	*	0.08
Latinx	0.03	0.05	0.003	**	0.11
Man	0.08	0.05	0.000	***	0.23
Straight	0.13	0.06	0.000	***	0.23
White	0.08	0.04	0.000	***	0.09
Woman	0.01	0.05	0.362		0.20
Interest					
Performance/Competence	0.87	0.07	0.000	***	**0.69**
Derogatory	-0.09	0.37	0.000	***	**0.58**
Asian	-0.23	1.86	0.000	***	0.11
Bisexual	0.02	0.15	0.300		0.15
Black	-0.03	0.13	0.032	*	0.09
Latinx	0.06	0.09	0.000	***	0.14
Man	0.06	0.06	0.000	***	0.28
Straight	0.13	0.07	0.000	***	0.14
White	0.06	0.06	0.000	***	0.02
Woman	0.04	0.07	0.010	*	0.27
Engineering Identity					
Recognition	0.18	0.03	0.000	***	**0.86**
Interest	0.62	0.04	0.000	***	0.29
Derogatory	-0.03	0.20	0.039	*	0.01
Asian	0.65	1.90	0.000	***	0.32
Bisexual	-0.04	0.12	0.002	**	0.04
Black	-0.02	0.09	0.033	*	0.10
Latinx	0.04	0.06	0.000	***	0.13
Man	0.12	0.05	0.000	***	**0.74**
Straight	0.12	0.06	0.000	***	0.18
White	0.05	0.04	0.000	***	0.09
Woman	-0.03	0.06	0.042	*	0.49
Sense of Belonging					
Engineering Identity	1.15	0.18	0.000	***	**0.38**
Derogatory	-0.06	0.34	0.000	***	**0.53**
Asian	-0.18	2.42	0.010	*	0.07
Bisexual	-0.04	0.12	0.002	**	0.02
Black	-0.02	0.09	0.033	*	0.04
Latinx	0.04	0.06	0.000	***	0.20
Man	0.14	0.10	0.000	***	0.28
Straight	0.14	0.12	0.000	***	0.07
White	0.06	0.07	0.000	***	0.03
Woman	-0.06	0.08	0.000	***	0.04
Asexual	-0.03	0.30	0.070	.	0.14
Queer Sexuality	-0.02	0.13	0.085	.	0.04

Total Effects

We found that participants who identified as Asian (β=-0.12, p=0.025, d=0.02), bisexual (β=-0.03, p=0.046, d=0.01), Black (β=-0.03, p=.031, d=0.13), or as a woman (β=-0.07, p<0.001, d=0.09) had lower performance/competence beliefs, albeit small effects for most. The same was true for participants in the derogatory group (β=-0.06, p=0.001, d=0.35), though the effect is medium. Opposingly, those who identified as Latinx (β=0.04, p=.003, d=0.17), straight (β=0.14, p<0.001, d=0.20), White (β=0.11, p<0.001, d=0.15), or who identified as men (β=0.16, p<0.001, d=0.37) had higher performance/competence beliefs with mixed effect sizes ranging from small to medium.

Next, for those who identified as Asian (β=0.13, p=0.009, d=0.001), Latinx (β=0.03, p=0.003, d=0.11), White (β=0.08, p<0.001, d=0.09), straight (β=0.13, p<0.001, d=0.23), a man (β=0.08, p<0.001, d=0.23), or a woman (β=0.08, p=0.362, d=0.20) had higher recognition beliefs with small effect sizes. Opposingly, those who identified as Black (β=-0.02, p=0.033, d=0.11) or bisexual (β=-0.02, p=0.045, d=0.09) and those in the derogatory group (β=-0.04, p=0.001, d=0.22) reported lower recognition beliefs with small effect sizes.

We found that those who identified as bisexual (β=0.02, p=0.300, d=0.04), straight (β=0.13, p<0.001, d=0.14), White (β=0.06, p<0.001, d=0.02), Latinx (β=0.06, p<0.001, d=0.14), as men (β=0.06, p<0.001, d=0.28), or as women (β=0.04, p=0.010, d=0.27) had higher interest perceptions with small effect sizes. Lower interest perceptions, with small effect sizes, were observed among those who identified as Asian (β=-0.23, p<0.001, d=0.11) or Black (β=-0.03, p=0.032, d=0.09), whereas lower interest perceptions, with medium effect sizes, were observed among those in the derogatory group (β=-0.09, p<0.001, d=0.58).

We found that those who identified as Asian (β=0.65, p<0.001, d=0.32), White (β=0.05, p<0.001, d=0.09), Latinx (β=0.04, p<0.001, d=0.13), straight (β=0.12, p<0.001, d=0.18), or as a man (β=0.12, p<0.001, d=0.74) had higher engineering identity. Notably, effects for participants who identified as men were large, whereas those for participants who identified as Asian were medium. Small effect sizes were observed for the remaining groups. Those who identified as Black (β=-0.02, p=0.033, d=0.10), bisexual (β=-0.04, p=0.002, d=0.04), or who were part of the derogatory group (β=-0.03, p=0.039, d=0.01) had a lower sense of engineering identity, with a small effect size. Those who identified as a woman (β=-0.03, p=0.042, d=0.49) also had a lower sense of engineering identity, with a medium effect size.

Finally, only those who identified as Latinx (β=0.04, p<.001, d=0.20), White (β=0.06, p<0.001, d=0.03), straight (β=0.14, p<0.001, d=0.07), or as a man (β=0.14, p<0.001, d=0.28) had a higher sense of belonging, with a small effect size. Those who identified as Asian (β=-0.18, p=0.010, d=0.07), Black (β=-0.02, p=0.033, d=0.04), bisexual (β=-0.04, p=0.002, d=0.02), asexual (β=-0.03, p=0.070, d=0.14), as a woman (β=-0.06, p<0.001, d=0.04), or as having a Queer sexuality (β=-0.02, p=.085, d=0.04) had lower sense of belonging with a small effect size. The derogatory group (β=-0.06, p<0.001, d=0.53) had lower sense of belonging with a medium effect size.

Limitations

This dataset uses several subsets collected across different years, raising concerns about limitations of the sample. The 2016, 2018, and 2019 studies account for the majority of the data, with the 2023 subset comprising only n=606 of the 9,903 (6.1%) of the sample and only n=3 of the derogatory

participants. Most of the data is from a similar three-year time period (2016-2019). Given the data timeframe, this observation raises concerns that the results may not be representative of the present, as the oldest subset is 10 years old. This paper is meant to be exploratory, asking if we can find results from a group of people who leave derogatory comments. As discussed in later sections, this paper achieves this goal, and we strongly encourage further research that is more representative of the present. Additionally, we argue that these results and their implications remain relevant, as the political climate has escalated since the data collection.

Discussion

Looking at the derogatory group, we found statistically and practically significant results across the dimensions of engineering identity, even after controlling for demographics. *In short, these participants have a lower sense of their performance/competence, interest, recognition, identity, and sense of belonging in engineering.* These results address RQ2 and open the door for further research. At present, there is limited research on this population. This paper provides evidence that this is a viable study population in engineering education and higher education.

Based on our findings that negative relationships are strongest for performance/competence, interest, and sense of belonging, we theorize that students in the derogatory group are exhibiting signs of identity threat [26], perceiving a threat to their identity as an engineer or to their role in engineering. An alternative explanation is imposter syndrome, which we cannot discern from current data. In either case, we hypothesize that those in the derogatory group feel insecure about their place in engineering, and that this insecurity may influence their behavior. It is possible that this insecurity was exacerbated by preconceived notions (or bigoted ideas) about diversity and inclusion efforts, leading these participants to lash out at the representation of these efforts in our research, specifically the demographic options. Our hypothesis is supported by the disproportionate number of derogatory responses observed in the study on diversity. Nonetheless, further research is needed to verify it.

We cannot discern the motivation behind these responses. However, we can connect these identified behaviors to recent literature regarding marginalized populations and culture in engineering. Within, marginalized students describe engineering as having a culture that is unwelcoming to them, where they perceive more microaggressions and bias, and lower perceptions of safety than their non-marginalized peers [27]. Black students specifically note being treated according to stereotypes by peers, such as being “thugs” or “unintelligent,” or witnessing White pride rhetoric [28]. Next, women students mention being disregarded or being sexualized [28, 29], while TGNC students describe being treated with disgust and ignored by group project partners [30]. Finally, LGBTQIA+ students describe a culture of hypermasculinity where they are treated as inferior, invisible, or are harassed by their peers [29, 31]. In all the above cases, marginalized students describe the mental burdens they bear due to racist, sexist, and queerphobic reactions to their marginalized identities. The derogatory responses we identified and explored are an extension of this behavior that continues to oppress marginalized students, either outright or in silence, and is a firm part of the cultures of engineering [31-34] and society [35-37]. We question just how normalized this behavior is in engineering, given how there are more participants who wrote derogatory responses than some of the marginalized populations they targeted. Moreso, we wonder how normalized these ideologies are for students who did not respond in a derogatory manner.

Implications and Future Work

We have limited information on the derogatory group within engineering and higher education, leaving significant gaps in the literature. Research across different contexts, time frames, and research areas would be useful for developing a more robust picture of who these participants are and their motivations. Granted, further research will be difficult, given that intentionally seeking out this population is difficult. Most likely, future research will have to focus either on quantitative studies using large secondary data sources or on qualitative studies of topics likely to aggravate this population, such as opinions on demographic options or inclusion efforts.

Beyond furthering understanding of students who provide derogatory responses, there exists an additional need to continually improve the engineering culture, which may, in part, alter students' perceptions of diversity, equity, and inclusion (DEI) efforts. This behavior exists because the engineering culture allows it. Cultural change should include teaching about diversity, equity, and inclusion, and calling out bigotry of all forms [34, 38]. An engineering culture that makes diversity and inclusion pillars would help discourage those with negative preconceived notions from joining, or potentially create an environment where they can unlearn them. For a better future, engineering culture should prioritize supporting marginalized students who are targeted by this behavior, while creating an environment in which this behavior is unacceptable. Changing the culture of engineering is no easy task and requires a collaborative effort by individuals from both majority and minoritized groups. Importantly, change should not be left only to those who are already marginalized by an exclusive engineering environment. As classroom leaders, professors, faculty, staff, and administrators can significantly influence the culture within engineering, thus acting as agents of change.

Stakeholders will have to determine the best methods for their institution and in navigating the current political climate. Some resources are likely to be local, such as university DEI or student belonging departments. These departments can be useful for connecting you with campus resources and/or working directly with you to create an inclusive environment, as they often hire experts to meet the needs of diverse student populations. There are also online resources, such as free trainings, introductions, and webinars, built by independent organizations [39,40]. Finally, many experts have written books or papers that can be used to learn about systemic oppression and the experiences of the people it affects [37, 41-44] and what you, as an individual, can do about it [45-47], including how to build inclusive engineering spaces [48-51]. We have provided these citations as a suggested starting point for stakeholders to learn and help build a more inclusive engineering culture. We recognize that this will not be easy work, but it is worth every bit of effort. Classrooms that have introduced inclusive practices and social justice have indicated a stronger STEM identity in marginalized populations [52, 53]. Changing the culture of engineering could be key to broadening participation of marginalized populations in engineering education and the workforce, who bring new, creative ideas to their respective fields. Everyone has work to do to achieve this future, and we encourage you to start sooner rather than later.

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Appendix A

Table A1. Engineering identity (Id) and sense of belonging (B) items

To what extent do you agree or disagree with the following statements
Idf. My parents see me as an engineer
Idg. My instructors see me as an engineer
Idh. My peers see me as an engineer
Idi. I have had experiences in which I was recognized as an engineer
Id j. I am interested in learning more about engineering
Idk. I enjoy learning engineering
Idl. I find fulfillment in doing engineering
Idm. I am confident that I can understand engineering in class
Ido. I am confident that I can understand engineering outside of class
Idp. I can do well on exams in engineering
Idq. I understand concepts I have studied in engineering
Idr. Others ask me for help in engineering
We would like to know how you feel that you fit in engineering and belong in your engineering community.
Ba. I feel comfortable in engineering.
Bb. I feel I belong in engineering.
Bc. I enjoy being in engineering.
Bd. I feel comfortable in my engineering classes.
Be. I feel supported in my engineering classes.
Bf. I feel that I am part of my engineering classes.

Appendix B

Table B2. Summary of all write-in responses from race/ethnicity, gender, and sexual orientation demographic questions, organized by group, theme, occurrences, and then alphabetically.

Grouping	Theme	Excerpts (number of occurrences)
Non-Derogatory Responses	Racial/Ethnic Identities	Indian/ Asian Indian (18)
		Caribbean/Caribbean American (8)
		African (4)
		European/Eastern European (4)
		Italian (4)
		South/Southeast Asian (4)
		Brazilian (3)
		Greek (3)
		Arab (2)
		Caucasian (2)
		Celtic/Irish (2)
		Haitian (2)
		Jamaican (2)
		Nepali (2)
		Pakistani (2)
		Persian (2)
		Albanian (1)
		American Indian (1)
		Bengali/South tuscan (1)
		Busnian (1)
		English (1)
		Filipino (1)
		Finish (1)
		German (1)
		Guyanese (1)
		Hispanic (1)
		Hunduran (1)
		Hungarian (1)
		Incan (1)
		Israeli (1)
		Japanese you racist fuck (1)
		Lebanese (1)
		Mediteranean (1)
		Mexican (1)
		Native Southern American w/African heritage & a Spanish last name (1)
		Nigerian (1)
		Nordic (1)
		Noth Asian/Turkmenistan (1)
		Puerto Rican (1)
		Romanian (1)
		Slavic/European (1)
		Spanish (1)

	Tamilian (1)
Gender Identities	Non binary/gender-nonconforming (3) Gender Fluid (2) Female (1) Transgender (1)
Sexual or Romantic Orientations	Pansexual (25) Demisexual/gray-ace/heteroromantic demisexual/Demisexual (can only see someone I love as "sexy") it is nice. I know I am weird. (9) Heterosexual/I'm straight (2) I like women... /A strong, independent black women (2) Atomosexual (1) Fluid (1) Homoromantic (1) Narcisexual (1) Panromantic (1) Possibly aromantic, but who knows really. Moreover, does it really matter? (1) trisexual (1)
Questioning or Unlabeled	I don't know for sure/i think?/Don't know (7) Bicurious/Curious (2) I dont claim a sexuality/not labeled (2) Confused (1) honestly don't really care enough to examine it deeply. (1) not labeled (1) Something else. I don't know yet. I'm still exploring. (1) Still questioning, but probably straight (1)
Did Not Want to Respond	None of your business (3) do not want to answer (1) Maybe (1) Myself (1) N/A (1) No (1) not saying (1) Other (1) Pick one (1) Refer to the above question (1) See above (1) Wish to be Open Minded (1) Wish to not answer (1) won't answer (1)
Religious Affiliations	Jewish (2) Hebrew Israelite (1) Muslim (1) Transubstantialized Christian (1)
Unspecified Mix	Biracial (2)

		mix/mixed (2)
		multiracial (2)
		Brown (1)
		Everything (1)
		Light skin (1)
		mixed nigga (1)
		Racially Ambiguous (1)
	Miscellaneous	Celibate (1)
		happily married (1)
Derogatory Responses		Bacon Cheeseburger/McDonald's Cheeseburger (2)
		67 chevy impala (1)
		A sparkly unicorn (1)
		Android (1)
		Arthropod (1)
		Bear (1)
		Bisexual plane (1)
		Box of Melted Crayons (1)
		Burnt Chicken Nugget (1)
		Christmas Tree (1)
		Giraffes (1)
		Goat (1)
		Golden retriever (1)
		Great white shark (1)
		Im a cow (1)
		I like bikes bikesexual (1)
		I like lawn chairs (1)
	References Items/Animals	I touch myself looking a washing machines (1)
		jeep wrangler (1)
		Large mouth bass (1)
		lawn chair (1)
		mailbox (1)
		Mango (1)
		Nuclear Submarine (1)
		Palm tree (1)
		Pineapple (1)
		Pot (1)
		Potato Peeler (1)
		Row Boat (1)
		Scooter (1)
		Sidewinder Air to Air missile (1)
		table (1)
		Toaster Oven (1)
		Toilet seat (Medium Rare) (1)
		Tomato (1)
		Toyota Camry (1)
	People	Daniel Ottenger (2)

	Chad Rowe (1) JOHN CENA (1) Maris Wahlberg (1) Paul Ryan (1)
Pop Culture	Gandolf (1) Pikachu (1) Rick and Morty Fan (1)
Self-Identifying	Damn Straight (2) all the straight (1) Hemispheric male (1) straight as a whistle (1) Straight as an arrow (1) White, but not Tumblr White (1) white engineer (1)
Reference Body Parts	DEEZ NUTZ (1) I am a rock-hard-abbs (1) I love black cock (1)
Ungrouped	Attack Helicopter/Apache Attack Helicopter/Helisexual (49) American/Merican/I am a American because i live in America (13) Furry/Pandakin (7) republican (3) Alien/Martian (2) Meme/Meme Lord (2) Transracial (2) Ya'll need Jesus (2) AAA Gender (1) Amazing (1) Beter (1) BFR (1) Brrt (1) Cracker (1) Dis Yoy Assume my gender (1) esports legend (1) Fight me (1) Gangsta (1) I like kids, ages 4-6 (1) King of the mole people (1) Lumbersexual (1) Man's Not Hot, Never Hot (1) Meat Popsicle (1) member of Phi Lambda Alpha Tau (1) non-alligent (1) Non-demi, case-by-case (1) only male but only into females (1) Racial fluid (1)

		supremeemagesticexcelency III (1) SUCCESS (1) This is a silly question with silly choices (1) Vinecian (1) Wednesday/Iguanagender (1) What was jesus was (1) 21 (1) ;) (1)
Alt-Write Responses	Attacking LGBTQIA+ Identities	there are only 2 genders (2) anything else is a mental disorder (1) Fagot (1) homosexuality is an abomination to God (1) Non-biological gender is a concept hindering socia (1) Normal (1) Play games, this gender bullshit is dumb as all hell. (mechanical pencil) (1)
	Social Identities Don't Matter	Human/a human being/human person (12) dont matter (2)