Student Attitudes about Diversity:

"If the field of engineering were more diverse, what would that mean for you?"

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***Abstract* — If the field of engineering were more diverse, what would that mean for you? The ways in which answers to this question vary provide useful insight into how students view efforts to advance diversity & inclusion in engineering. In this paper, we use the *Tripartite Model of Attitude* to explore students' evaluative reactions to a hypothetical, more diverse engineering environment. We interviewed undergraduate (n=19) and graduate students (n=22) at a single institution. We asked each student to imagine a world in which the field of engineering were more diverse and, subsequently, describe how their personal experience might be different. Our findings highlight a range of attitude components such as engineering career changes at the personal and global levels as well as changes in interpersonal interactions. Across participants, themes suggest that majority students articulate more functional, cognitive elements (e.g., being exposed to more diverse ideas), while underrepresented students more often discuss affective elements (e.g., feeling more comfortable). Our results advance understanding of students' attitudes about diversity and enable us to provide practitioners with suggestions for discussing this topic with engineering students. This work is part of a larger effort to better integrate diversity into engineering education and is directly geared towards educators and researchers interested in inclusion and diversity.**

Keywords—diversity, inclusion, student attitudes

I. Introduction

Broadening the participation of women and racial minorities (e.g., African Americans, Hispanics, and Native Americans) is a key strategy for expanding and strengthening the national engineering workforce [1]. In 1980, the United States Congress passed the Science and Technology Equal Opportunity Act, which officially deemed the diversification of engineering a national priority [1], [2, Sec. 32(b), Part B of P.L. 96-516]. The federal government called for increased efforts to promote equal representation of women and men of all racial, ethnic, and economic backgrounds [1]. Other organizations such as the American Society for Engineering Education (ASEE) and the National Academic of Engineering (NAE) have echoed these calls [3]–[5]. However, over three decades later, minimal progress has been realized [1], [5]–[7].

In light of this persistent challenge, the engineering education community has responded with numerous practice-based initiatives. Recent efforts include the Summer Engineering Experience for Kids (SEEK) program sponsored by the National Society of Black Engineering [8]; Hypatia & Galileo living-learning communities at Virginia Tech [9]; the Engineering Allies program at Ohio State University [10]; and the Dissertation Institute recently funded by the National Science Foundation [11].

The engineering education community has also explored diversity & inclusion through educational research. For example, the development and offering of the aforementioned Dissertation Institute is intentionally paired with a research project grounded in the expectancy-value theory of motivation. Research grounded in such theories offers critical insight for designing effective interventions because all current perspectives on learning assert that learning requires active participation of students [12], making student motivation and engagement an integral component for effectiveness of diversity efforts. By incorporating research on learning and motivation theory with practice-based efforts, initiatives such as the Dissertation Institute enable practice and research to work in parallel towards a shared goal. Such efforts are closely aligned with recommendations from the research-to-practice cycle [13].

While numerous researchers have explored the experiences of underrepresented students [14]–[16], less scholarship has focused on how to effectively engage students in diversity & inclusion efforts. We aim to make a contribution in this area. More specifically, the purpose of this paper is to explore the different ways in which students describe the impact of an increase of diversity in engineering on their experiences. To realize this purpose, this study will explore the following question: *What are the different attitudes engineering students express regarding changes in the diversity of engineering fields*? By answering this question, we will inform current and future efforts to engage students in the advancement of diversity and inclusion in engineering.

II. The Impact of Diversity on Engineering Experiences

An overarching goal of diversity efforts in engineering is to improve representation of traditionally underrepesented groups. The National Science Foundation (NSF) defines

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underrepresented groups as Alaska Natives, Native Americans, Black or African Americans, Hispanics, Native Hawaiians, and Persons with Disabilities [17]. In engineering, women are also considered underrepresented [1]. According to ASEE [6] less than twenty percent of the 106,658 bachelor degrees in an engineering discipline awarded in the United States for engineering in 2014 were conferred to women. In terms of racial/ethnic diversity, less than 4% percent were awarded to African Americans and less than 10% to Hispanic Americans. Unsurprisingly, undergraduate engineering classrooms are comprised predominantly of individuals who, as Foor, Walden & Trytten [14] describe, are the historical, mythical norm of engineering: high-achieving, white males.

Though historical efforts have primarily focused on gender [18]–[20], race [21], [22], and ethnicity [23], additional dimensions of identity—as well as intersections of identity dimensions—may impact experiences in engineering [24]. For example, research has explored the experiences of students and faculty who identify as female and a particular racial minority [24]–[27]. Other studies have examined the experiences of first-generation and low-income students [28] or those with a veteran status [29], [30]. Lastly, recent efforts have examined the experiences of people who identify as lesbian, gay, bisexual, transgender, queer, or questioning [31], [32] as well as current representations of students with disability [33].

Though the argument for diversity is usually centered around developing creativity, teamwork, innovation, and problem solving [e.g.,1], previous research suggests that an increase in diversity will also impact the student experience. For example, researchers have investigated the interdependency of the climates that student perceive and compositional diversity. Foor, Walden, and Trytten describe the experience of a student who is a "female, multi-minority, and from a socio-economicially diadvantaged background" and explore her feelings as an outsider in an environment that is predominantly white and male [14]. Similarly, Brown, Morning, and Watkins [21] studied perceptions of campus climate and found that African American undergraduate engineering students had more favorable perceptions when enrolled at a Historically Black Colleges or University (HBCU). As we strive to broaden participation, it is important to recognize the different conceptions students likely have about what improving diversity will mean for them personally. Given the impact of diversity on engineering demonstrated through these studies and others, it is critical that researchers explore the ways in which students' identities and interactions might be affected given such an increase.

Literature also suggests that students might hold negative or neutral appraisals about an increase in diversity—particularly in such an object-oriented, white male-dominated field such as engineering. In support of this idea, Burack and Franks [34] explain how some people assume diversity to be anti-individualistist, perceiving it to respect membership to a certain group over an individual's achievement or individuality. Thus, as we work to drive positive change and increase diversity in engineering, it is important to understand how *all students* form and hold their various beliefs about it.

III. Conceptual Framework: Tripartite Model of Attitude

To designate and delineate important constructs for this study [35], we chose the Tripartite Model of Attitude [36] as a conceptual framework. First posited by Spooncer in 1992, the Tripartite Model suggests that attitudes are comprised of three components: (1) feelings, (2) beliefs, and (3) behaviors. From a theoretical perspective, the Tripartite Model of Attitude (Figure 1) is useful for examining attitudes about diversity because a person's attitude actively and dynamically impacts their behavior [36]. Students' attitudes about a topic are believed to directly predict and influence their behavioral responses to the topic [36]; therefore, if we want to engage students in diversity and inclusion efforts, we must understand the attitudes they hold about the topic. The Tripartite Model of Attitude provides a salient framework for increasing such understanding.

As defined in Figure 1, the *feelings* component of attitude pertains to emotion and is represented in this model as verbal statements of feeling [36], [37]. The *beliefs* component is related to cognitive response and is typically represented by verbal statements of belief [36], [37]. The final component of attitude in the Tripartite Model is *behavior*, which is related to overt actions and typically represented through verbal statements about intended behavior [36], [37]. The theoretical definitions of the components of attitude, according to the Tripartite Model, served as an analytic lens for this study.

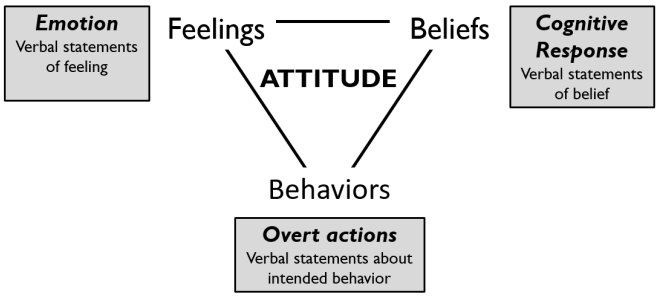

Fig. 1. Tripartite Model of Attitude. Modified from [36].

IV. Methods

This data was collected as part of a larger study on students' conceptions and attitudes about diversity in engineering. Though data from the larger project was collected via quantitative surveys and qualitative interviews, the current study will focus on the semi-structured interviews. Methodological decisions were grounded in a pragmatic worldview [38] with the intention of enlightening understanding of students' attitudes about diversity in engineering to inform diversity and inclusion efforts.

As noted, the purpose of this research was to explore students' reactions to a hypothetical increase in diversity within the field of engineering. To address this purpose, we interviewed graduate and undergraduate students. During each

interview, students speculated on the personal impact of an increase in diversity in engineering fields. We analyzed their responses using a hybrid coding scheme of deductive, in vivo, and descriptive coding. Student answers were grouped based on their feelings, beliefs, and behaviors. Our methods are further discussed in the following sections.

A. Context and Participants

The research site was a large, predominantly white research institution. Participants were recruited via a survey distributed to undergraduate students in a living-learning community (LLC) and graduate students across the college of engineering. The data here represents a purposive sample because diversity-related initiatives were ongoing in both the LLC and the graduate school at the current institution. Participant demographics for this study are shown in Table 1.

Table 1: Summary of participant demographics.

Race/Ethnicity	***Male***	***Female***
American Indian or Alaskan Native	0	1
Hispanic or Latino	3	0
Asian	3	5
Black or African American	0	2
White	11	12
Two or more	2	2
Total	**19**	**22**

B. Data Collection

We collected data using semi-structured interviews. While the entire interview broadly explored students' perceptions and motivational beliefs, the present study focuses on the answer to the question "If engineering were more diverse, what would that mean for you personally?" Table 2 summarizes the interview question and follow-up probes. In total, 19 undergraduates and 22 graduate students participated in interviews. All participants were provided a $20 Amazon card. Interviews lasted between 30-75 minutes, were transcribed by a professional transcription service, and all identifying information was removed prior to analysis. All research protocols were approved by the Institutional Review Board (#16-130).

In the interest of transparency, a final note about the data collection process concerns the diversity of the research team. Six different researchers conducted interviews and, though no attempts were made to match the race or gender of the researchers and participants, it is difficult to speculate on the effect this had. However, because diversity-related topics are sometimes sensitive, efforts were taken in protocol development to avoid language that might stigmatize participants and thus prevent them being honest.

Table 2: Relevant subset of interview protocol

Question	***Probes and Follow-up***
If the field of engineering were more diverse, what would that mean for you personally?	What would diversity in engineering look like to you?
	What would it mean for engineering to be more diverse?
	How would diversity in engineering impact you?
	What would diversity in engineering mean for you as a person?

C. Data Analysis

Prior to analysis, audio recordings of each interview were transcribed verbatim. In an effort to minimize researcher bias, data was reviewed blind during this analysis; that is, data was first analyzed without correlating participants' demographic information to their responses. As shown in Figure 2, a hybrid coding scheme composed of elemental coding methods [39] was used for data analysis, with the Tripartite Model [36] serving as a lens for data analysis.

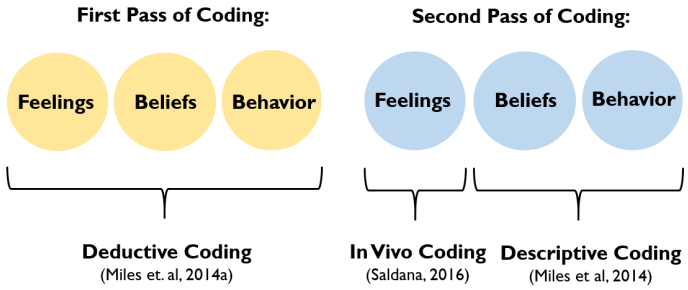

Fig. 2. Hybrid coding scheme used for data analysis. Circles represent the three constructs of the Tripartite Model [36], which served as a lens for this analysis.

The initial coding pass was conducted by the lead author using hard-copy printouts of interview data, following the recommendations of Saldana [39] who suggests that "manipulating data on paper and writing codes in pencil… gives you more control over and ownership of the work." Because interviews were conducted with a relatively small sample (n=41) and focused only on responses to a single question, an initial coding pass on hard-copy printouts was feasible. Initial passes of coding used deductive coding [35], where a provisional list of codes was developed using the *feelings*, *beliefs,* and *behaviors* constructs of the Tripartite Model of Attitude [36]. Initially, code definitions were developed using Jain's [36] definitions for constructs of *feelings, beliefs, and behaviors* in the Tripartite Model of Attitude. However, further analysis necessitated operationalization of definitions according to participants' words, or verbal articulation; this methodology is similar to that used by Matusovich, Streveler, and Miller [40].

To obtain a more detailed inventory of prevalent codes in each of the three constructs, the lead author used a hybrid of elemental coding methods during a second coding pass [39].

Attitudinal constructs of *beliefs* and *behaviors* were analyzed using descriptive coding [35], whereas the construct of *feelings* was analyzed using *in vivo* coding [35]. Importantly, descriptive coding was not chosen as the default coding method as this method alone was not sufficient to gain key insights into the deep meaning of participants' responses. To compensate for the limitation of this method, *in vivo* coding was used in combination with descriptive coding. *In vivo* coding provided a salient method to capture the authentic language of the participants and respect their voices [39], which was particularly important for the attitudinal construct of *feelings*, which can be deeply personal in nature.

After the lead author completed initial and secondary coding passes, a second researcher used the preliminary codebook on a subset of the data to verify codes and establish inter-coder reliability. Discrepancies were discussed until mutual agreement was reached. Following codebook recommendations of Saldana [41], the final codebook is provided in Tables 3a-c.

Table 3a: Codebook for *Beliefs* Construct

Code	***Operational Definition***
No change	Belief that a more diverse engineering field would not change anything
Global change to the field of engineering	Belief that a more diverse engineering field would result in global changes to the field of engineering (i.e. career pathways, pay gaps, overall improvement in the field, etc.)
Changes to one's personal engineering career	Belief that a more diverse engineering field would result in changes to one's personal engineering career (opportunities, experiences, etc.)
Less emphasis on diversity	Belief that a more diverse engineering field would result in less emphasis on diversity in engineering

Table 3b: Codebook for *Behaviors* Construct

Code	***Operational Definition***
Interact differently	Different (diverse) interactions will result from diversity in engineering
Communicate differently	Different communication will result from diversity in engineering
Learn differently	Different learning will result from increased diversity in engineering
Solve problems differently	Different problem solving will result from increased diversity in engineering (improve, quicken, become more robust, etc.)

Table 3c: Codebook for *Feelings* Construct

Code	***Operational Definition***
Current emotion	Participant expresses a current emotion(s) about diversity (or lack thereof) in engineering
Projected emotion	Participant expresses a projected emotion about how diversity in engineering would make them feel

To reduce researcher bias, no identifying information was connected to student responses during first or second passes of coding. After coding was completed, participants' demographic information was matched with coding analysis to allow the researchers to examine how attitudinal components varied across race/ethnicity, gender, and academic level.

D. Limitations

We acknowledge that demographics of our sample are not representative of the university from which participants were recruited. An important limitation of this study is the self-selection bias of our sample, as participants indicated interest in being interviewed about their conceptions of diversity. While the following results may not be transferable to every setting, they offer critical insights into students' attitudes about diversity in engineering and may be used to enlighten future efforts in engineering diversity education.

V. RESULTS

The following sections identify emergent themes within each attitudinal component of the Tripartite Model. For each attitude component, we provide a table of codes paired with representative quotations, followed by a narrative summary of emergent themes in each construct. We conclude this section with a comparison of themes across academic status, race/ethnicity, and gender.

A. Beliefs

Students' responses for the attitudinal component of *beliefs* reflected a broad spectrum of beliefs about what diversity in engineering would personally mean for them, ranging from "I don't think it would change a whole lot…" to ideas about how diversity might significant impact the global field of engineering. Students' *beliefs* about how an increase in diversity in engineering were divided into four distinct categories: 1) no change, 2) global changes to the field of engineering, 3) changes to one's personal engineering career, and 4) less emphasis on diversity in engineering. Table 4 provides a representative quotation for each code.

Table 4: Codes for *Beliefs* Construct of Tripartite Model

Code	***Representative Quotation***
No change	*I don't know that it would change things. I think it would mean I'm working with a whole bunch of different of different people. I don't know that it would change much for me, personally.*
Global changes to the field of engineering	*Well I would hope the pay gap would decrease a little bit. I think it would just be easier for people of more diverse backgrounds to get jobs, to hold those jobs, be respected in those jobs, get higher positions in those jobs. I wouldn't say it'd be a perfect world necessarily but I think it would be a lot more equal across the board definitely.*
Changes to one's personal engineering career	*I would get less benefits for being qualified as diverse. I'm not even joking. I feel, yeah, that's why sometimes because I feel almost I've definitely gained a lot of the positive things within engineering because wow, she's a female, and she's ethnic, and she's in engineering. If the field were to become 'Diverse' in terms of ethnicity, race, gender, sex, then I would lost those perks, which I'm fine with.*
Less emphasis on diversity	*It would probably mean for me if it were more diverse, for me maybe it would mean that I don't think about it so much, because the only reason that we talk about diversity in engineering is because we are not diverse. If we were diverse, this wouldn't be a problem, we wouldn't be talking about it, but we're not diverse, so we have to talk about it. If we got to a point where we didn't have to talk about this anymore, or if we had to talk about it less that would be great, that would be a sign to me that we're going in the right direction.*

Many students posited that diversity might result in more equitable access to engineering careers for persons of diverse backgrounds. One student wagered that diversity in engineering would mean that "more people would have opportunities they deserve", while other students reflected on specific, global changes to the engineering field such as decreased pay gaps between men and women and broadened career pathways. Other students posited that a more diverse engineering field might strengthen the relationship between society and the engineering profession. One student reflected:

> "They don't really know [engineers] impact society in so many ways. Construction, medicine, computers. If we include people from different backgrounds, different economical levels, different countries, then they're going to start outreaching […] then more people would appreciate what we do for society."

In contrast to global statements of *beliefs*, several students responded with personal cognitive statements, taking ownership of their beliefs about how a more diverse engineering field might change their own career. One example of a positively-framed belief was given by a majority student, who articulated a belief that a more diverse engineering field would provide him with "more opportunities". Another student articulated her belief that diversity in engineering would help her resolve the motives for her hire by engineering companies. She said:

> "For me, very personally, I never wonder if I got a job because I was female […] There's things where I think my resume would get me in on my own merit but it makes you wonder in a field where there's such disparities, did they pick me because higher management told them that they finally need to hire a female?"

However, others students' articulated beliefs that a more diverse engineering field would negatively impact their careers. Notably, several students from populations that have been historically underrepresented in engineering articulated worry that increased diversity in engineering would diminish their own present career opportunities. With candor, one student reflected:

> "…that would probably hurt me, getting a job wise […] at least my family is under the impression that it was easier for me to get into the engineering program because they want girls because how low the numbers are. It would probably hurt me in like the ability to get things or special treatment. I think generally it would make the world better so I'm okay with that."

In this quote, the student wrestles with the notion that an aspect of her identity- being a woman- may have positively impacted the opportunities available to her. She articulates a *belief* that an increase in diversity in engineering might make it more difficult for her to access opportunities in engineering. This *belief*, similar to those reflected by other students, demonstrates that some students may hold negative appraisals of the impact of an increase of diversity in engineering.

B. Behaviors

Themes within the construct of *behaviors* tended to center on usefulness; in other words, students' mostly reflected on various future behaviors that would be more productive if the field of engineering were more diverse. Students posited that four main *behaviors* would be impacted by an increase in diversity: 1) interaction, 2) communication, 3) learning, and 4) solving problems. A list of codes and representative quotations within the *behaviors* construct is shown in Table 5.

Table 5: Codes for *Behaviors* Construct of Tripartite Model

Code	***Representative Quotation***
Interact differently	*The main thing would just be interacting with different people. For undergrad level, if it was more diverse, nine out of the ten groups in the class wouldn't be all white males. There would actually be people from other, different races and different backgrounds, different ethnicities. For me, it would be interacting with people who aren't like me.*
Communicate differently	*I guess it would still come down to ensuring that I'm able to understand, communicate with the other people that I'm working with… it would probably change how I communicate to some extent.*
Learn differently	*I value learning about things from around the world so I believe it would be a better opportunity to learn more, at least for me on a personal level, more of what's going on.*
Solve problems differently	*Then, if it was completely diverse field, I feel like problems would get solved a lot quicker… I feel like it everybody understood the engineering problems of the world, from all viewpoints, then those problems would be addressed quicker, in my opinion.*

Several students made explicit connections between the future behaviors of interacting with diverse people and solving problems differently. For instance, one student noted that if the field of engineering were more diverse, they would "interact with people from different backgrounds" which would lead to "different ideas or wild ideas of how to solve problems." Another student said:

> "I guess it means I get to hang out more with different people. I don't think the… How do I say this? It's maybe not the science of engineering would change that much itself, but I think when you have a lot of different eyes… by eyes, I don't just mean people. I mean with different backgrounds and stuff, looking at the same problem. As a group, we all grow more. I think for me, what it would mean is engineering as a field would get stronger. Who doesn't want their science to get stronger? Yeah."

Other students made distinctions between interacting differently and learning differently. These students wagered that a more diverse engineering field would lead to solving problems in a more robust way because of more robust learning. One student remarked:

> "For me, it would definitely be learning new things. Like learning ideas, how other people think, how people from different countries, what they are doing to solve different problems. That's the most important thing at least from the aspect of engineering. Diversity, for me, in engineering would be that getting ideas and data and all the stuffs, research from around the globe."

While most students' reflections on the impact of a more diverse engineering field were positive, several students' articulated honest reflections on future behaviors that would be much more challenging if such a change were to occur. Several students noted that increased diversity in engineering would make their day-to-day communication much more difficult. In a candid interview response, one student said:

> "I think it would be a lot harder because I would have to figure out a way to talk to somebody who didn't have water growing up and never knew were their next food was going to be…"

In contrast, several students articulated deep-rooted interest in communicating with persons from different backgrounds. One student remarked:

> "I think for me, I would just enjoy it. I love talking to people who are not like me […] Because I love… when I'm talking to people from different cultural backgrounds or whether they grew up in the North versus the South, because if you talk to New Englander versus Southerner, it's very different. If you talk to somebody who has a PhD and has been classically educated in their field versus somebody who has a GED and is not educated. People who are from- I don't know if I've already said different religions, I'm sure I did. I just like talking about different things to different people, and I think it furthers your understanding of how you see the world. So I think I would just enjoy it."

This student articulated that her communication (i.e. *behavior)* would change in a positive manner as a result of increased diversity in engineering. Other students articulated positive changes to *behaviors* of problem solving, learning, and interacting as a result of increased diversity in engineering.

C. Feelings

For the construct of *feelings,* students*'* responses were divided into two distinct categories: 1) current emotions, which included emotions about the present diversity in engineering, and 2) projected emotions, which included emotions about a futuristic increase in diversity in engineering. Responses in the category of current emotions typically reflected an overarching feeling of lack of belongingness to the field of engineering. Similarly, students' who projected how a more diverse engineering field would make them feel tended to discuss affective ideas related to belongingness, such as "I would feel like I belong." Representative quotations from each category are displayed in Table 6.

Table 6: Codes for *Feelings* Construct of Tripartite Model

Code	***Representative Quotation***
Current emotion	*there's times where I know I go into situations, and it's awkward, because I'm the only woman, and people treat me differently because of that.*
Projected emotion	*I think I would feel better just in general, with I feel included, I feel like I belong, and I think that's important. I think my motivation would be higher, yeah.*

Some students talked openly about a lack of diversity in engineering contributing to impostor syndrome, or a feeling of "intellectual phoniness" [42]. One student openly reflected on the impact of a more diverse engineering field by saying:

> "I'd probably feel more comfortable. Coming in, you probably wouldn't have a great level of impostor syndrome. Should I be here? Am I smart enough, type of thing. I think it would allow me to succeed faster and better because I wouldn't be thinking self-doubting thoughts. Yeah, I think it's like a confidence boost in general."

This student asserted that if the field of engineering were more diverse, they would feel more confident in their ability to succeed in engineering. Other students explicitly noted that a more diverse engineering field would increase their feelings of belongingness to the engineering community. One student noted that they wished they could see another "black female" in engineering so that they did not feel "excluded from the group". Students' affective statements largely centered around increased level of comfort, belonging, or satisfaction if the field of engineering were more diverse.

D. Prevalence of Attitudinal Components

Across all student responses, we analyzed prevalence of attitudinal components of the Tripartite Model, where prevalence refers to the number of individual students who articulated the component in their interview responses. The construct of *beliefs* (articulated by 23/41 participants) was equally prevalent for each demographic group, regardless of race, gender, or academic status. *Behaviors* (articulated by 17/41 participants) were the second most commonly articulated attitudinal component, followed by feelings (articulated by 14/41 participants). Importantly, most students articulated more than one construct of attitude when reflecting on the interview question.

E. Comparison of Results Across Demographics

In addition to focusing on themes in responses across all demographics, we examined the ways in which responses varied according to academic status, gender, and race/ethnicity. To compare responses by academic status, we segregated responses by undergraduate and graduate student status. As shown in Figure 3, *beliefs* tended to be consistently prevalent for both undergraduate (10/19 participant) and graduate students (13/22). In this sample, graduate students tended to talk about intended *behaviors* (10/22) slightly more than undergraduate students (7/19). Additionally, graduate students (9/22) were much more likely than undergraduate students (5/19) to talk about a *feelings* component of attitude.

As shown in Figure 3, *beliefs* were nearly equally prevalent in the attitudes of men (10/19 participants) and women (13/22) in our sample. Persons who identified as female (7/19) were more likely than persons who identifed as male (10/22) to discuss future *behaviors*. One of the most striking differences between responses of males and females was the prevalence of the *feelings* construct; women (10/22) discussed affective components more frequently than men (4/19).

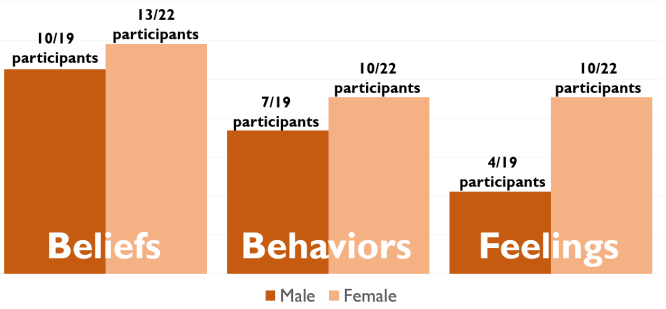

Fig. 3. Prevalence of constructs by gender.

We also compared responses for persons who identified as white and persons who identified as people of color (e.g., Hispanic/Latino, Black/African American, and Native American/Alaskan Native). In our sample, *beliefs* were nearly equally prevalent for both white persons (13/23 participants) and persons of color (3/6). White persons tended to discuss future *behaviors* more often (10/23) than persons of color (2/6). The largest variation in responses was seen for *feelings*, with white people (10/23) discussing affective components of attitude more frequently that persons of color (1/6). It is important to note that white women were overrepresented in our sample.

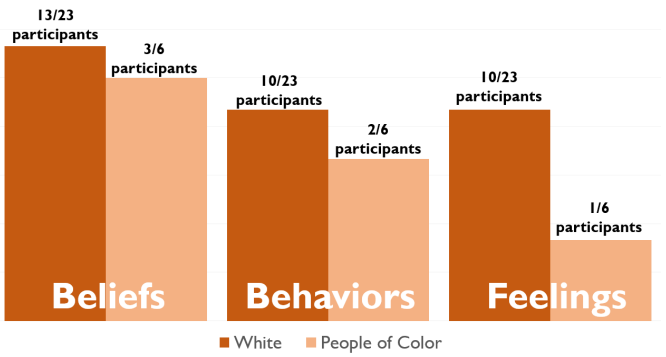

Fig. 4. Prevalence of constructs for white people compared with people of color. .

Lastly, we analyzed themes by dividing data in two groups: 1) women and underrepresented minorities (URM), including persons who identified as Hispanic/Latino,

Black/African American, Asian/Pacific Islander, Native American/Alaskan Native, and more than one race; and 2) white men. As shown in Figure 5, *beliefs* were discussed almost fairly equally across groups. Intended *behaviors* tended to be more prevalent in the responses of women and URM (13/30 participants) than white men (3/11). The most striking difference in responses was for the construct of *feelings,* with women and URM (12/30) speaking much more frequently about affective components about a futuristic increase in diversity in engineering than white men (2/11).

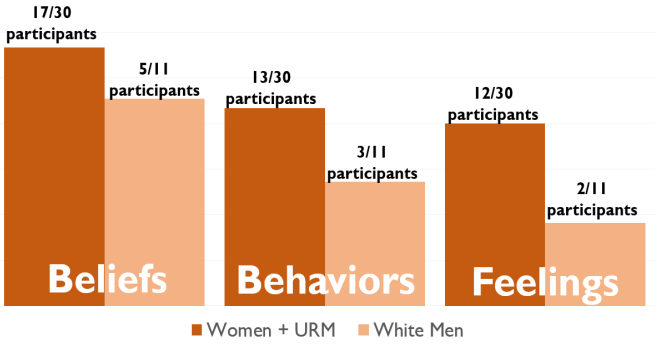

Fig. 5. Comparison of construct prevalence between women and underrepresented minorities (URM) and white men..

VI. Discussion

Through interviews with undergraduate and graduate engineering students, this paper explored what students believed an increase in diversity might mean for them personally. The Tripartite Model of Attitude, which distinguishes *beliefs, behaviors,* and *feelings* as components of attitude, was used as a lens for data analysis. Students' responses reflect a spectrum of attitudes.

A majority of students (23/41) discussed functional, cognitive components of attitude, such as the *belief* that increased diversity would impact their careers or cause global changes to the field. Students also spoke about how an increase in diversity would affect their *behavior*, citing changes in problem solving, communication, interaction, and learning. *Feelings*, or affective components, were also articulated; some students reflected on current emotions due to the lack of diversity in engineering, while other students projected emotions that they might experience if the field of engineering were more diverse. Importantly, we note that students' responses for each attitudinal construct were wide-ranging, including both positive and negative appraisals. These findings are consistent with current literature suggesting that, in addition to positive attitudes about diversity and inclusion in engineering, students may also express negative or neutral attitudes about the topic [34].

Though *beliefs* tended to remain consistently prevalent across all demographics, women and underrepresented minorities (URM) were more likely to reflect affective components of attitude, or *feelings*. Importantly, nearly all emotions articulated by women and URM hinged on a desire to "belong", or feel a sense of connectedness and belonging to the field of engineering. These results closely echo Simmons and Martin's [43] reference to the engineering community as a "closed club" that can impede the development of a sense of belonging for some students. Additionally, these results are consistent with current literature that suggests that aspects of identity—both visible and non-visible—influence students' experiences, and ultimately, their attitudes about diversity in engineering [14], [21], [24], [25], [27]. We must seriously consider the experiences of underrepresented students, and how these experiences contribute to a sense of community (or lack thereof). In addition to impacting students attitudes, the development of a sense of belonging has been shown to positively influence engineering career goals [44]–[46], higher GPAs [47], and persistence in an engineering major [46], [48].

VII. Conclusions

The purpose of this paper was to explore the different ways in which students describe the impact of an increase of diversity in engineering. The themes identified in this study advance understanding of the attitudes student hold about diversity and offer insights to inform future efforts in engineering. Our findings point to opportunities to leverage the current attitudes of students, both minority and majority students, in ways that might more effectively communicate the desire to broaden participation in engineering and encourage students to engaged in diversity and inclusion efforts.

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