The Missing Misrecognition in Recognition and Engineering Identity Research

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Identifying Misrecognition in Engineering Identity Research

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Introduction

Engineering identity and its subcomponent, recognition, is highly researched in engineering education. Numerous studies have revealed that engineering recognition is connected to increased student retention and an engineering student's developing sense of belonging (Cribbs et al., 2016; Hatmaker, 2013; Rover, 2008; Wang & Hazari, 2018). Additionally, recognition is invaluable because of its capability to demonstrate how students form relationships within engineering, its ability to verify the other two components of engineering identity, competency and performance, and its ability to shed light on the experiences of underrepresented and marginalized students in STEM (Carlone & Johnson, 2007; Rodriquez et al., 2017; Rohde et al., 2019).

This topic has been studied using various methodologies (Godwin, 2016; Rodriquez et al., 2017) to explore ethnicity's impact (Kendall, Denton, et al., 2019; Ross et al., 2021), K-12 development and class status (Capobianco et al., 2012; Choe & Borrego, 2019), pedagogy (Kendall, Procter, et al., 2019) and familial influences (Koul, 2018). These scholars' work has greatly increased our understanding of engineering identity recognition and its impact on student persistence and success. However, we noted a trend in some of this scholarship. Several studies approached engineering identity and recognition through survey assessments that measured the extent to which students recognize themselves as engineers or a subject discipline expert and how much a limited selection of people in their lives (family, friends, peers, and instructors) recognize them within these parameters (Cribbs et al., 2015; Godwin, 2016; Kendall, Procter, et al., 2019; Prybutok et al., 2016). Though these studies have made invaluable contributions, we identified an

opportunity to consider these findings through the need for more conversation regarding the other aspect of recognition: *misrecognition*.

Recognition is important. However, exploring when a student does not feel seen is just as critical to understanding engineering identity. As researchers have reasoned, recognition is vital to understanding engineering students' relationship formation and their ability to develop a sense of belonging. Nevertheless, understanding recognition necessitates examining the experiences of negative recognition that impact a student's ability to form relationships with their peers, their sense of belonging, and their overall persistence within their engineering program and career.

This paper demonstrates how we drew from theoretical and philosophical recognition frameworks to define misrecognition. We also identify its presence in our interviews of fifteen biomedical engineering (BME) undergraduate students who identified as female, binary, and of Black ethnicity at a research-intensive university in the southeast United States. This work highlights the need for more discussion of misrecognition within the literature. Also, it provides a framework and language to identify and understand these experiences of misrecognition within engineering education among students of color.

Literature Background

A large swath of the present research focuses heavily on framing and examining recognition through two primary questions: to what extent a student feels seen by others as an engineer (or STEM-related discipline) or the extent they see themselves as an engineer (Bahnson et al., 2021; Choe & Borrego, 2019; Godwin, 2016; Kendall, Procter, et al., 2019; Prybutok et al., 2016). Though this research has made valuable contributions to the field, this one-sided approach has overlooked the duality of recognition. If recognition is significant within the classroom, lab, and academic setting, misrecognition or a lack of recognition must also be as impactful.

Research indicates that positive recognition supports and fosters a sense of belonging and persistence for engineering students (Capobianco et al., 2012; Cribbs et al., 2016; Rodriquez et al., 2017; Rohde et al., 2019). Therefore, drawing from this body of work, one can assume that recognition's counterpart, misrecognition, not only exists but creates barriers and challenges for students. This challenge is especially concerning within communities of color and communities with limited resources and opportunities. Nevertheless, there is less research discussing misrecognition, especially within engineering education. A search for "misrecognition" within the Journal of Engineering Education database resulted in one article and no articles in the conference proceedings for the American Society for Engineering Education (ASEE), the European Journal of Engineering Education, and Studies in Engineering Education[i].

In this study, we bring attention to the literature that has quantitively assessed a student's recognition through two primary questions. These studies have made significant contributions to the field but have focused mainly on the aspect of being seen (recognized) as an engineer and have measured this concept through a student's self-reflection and through their recognition of how much the people in their lives see them as an engineer:

- "Parents/Relatives/friends see you as a physics person" and "Science teacher see[s] you as a physics person." (Hazari et al., 2010)

- "My parents/relatives/friends see me as a physics person; my teacher sees me as a physics person." (Godwin et al., 2013)

- "Do the following people see you as a mathematics person?:" Parents/relatives/friends/mathematics teacher. (Cribbs et al., 2015)

- "Do the following see you as an engineering person: (1) yourself and (2) the engineering instructor" (Prybutok et al., 2016)

- "My parents see me as an engineer. My instructors see me as an engineer. My peers see me as an engineer. I have had experiences in which I was recognized as an engineer." (Godwin, 2016)

- "I see myself as an engineer." "My advisor sees me as an engineer." "I have had experiences in which I was recognized as an engineer." (Bahnson et al., 2021)

- Friends, family, peers, and advisors see me as an engineer (Choe & Borrego, 2019)

- Ask students to rate to what extent parents, relatives, and friends see them as engineers. (Kendall, Procter, et al., 2019)

As we reviewed this work in parallel to our research project, we were led to consider recognition in other ways. For the many studies that considered the experience of being seen and assessing it within self-reflection and the perspective of others, how did a lack of recognition manifest? Therefore, we set forth to examine misrecognition to contribute to enriching the present engineering identity recognition research.

Theoretical Framework

A critical understanding of recognition and misrecognition through an in-depth analysis of the relevant social science literature is a critical aspect of this study. This section presents an abbreviated analysis of recognition and misrecognition from a sociocultural viewpoint. First, our theoretical analysis provided the theoretical recognition framework not previously discussed in the engineering education literature. Second and most importantly, this theoretical analysis provided the foundation for the codebook to identify and understand the negative recognition experiences of the student participants deeply.

Researchers argue that recognition dramatically impacts one's identity formation, mental health, sense of belonging, and access to the benefits and privileges of the desired social group (Fraser, 2001; Honneth, 1995; Schweiger, 2019; Swanson, 2005; Taylor et al., 1994; Tully, 2000). This process is highly dependent upon subtle interactions, such as when others positively acknowledge one person's contribution to the group or community or when a person's specific cultural attributes set the tone for inclusion and not exclusion (Fraser, 2008; Honneth, 1995; Tully, 2000). When recognition is a positive process, a person is recognized as a group member and can benefit from that group. For example, a person seen as a valued member of an organization can fully partake in informal and formal activities that can advance that person's standing. Thus, recognition is critical to identity formation and sustaining one's professional standing and livelihood (Hegel, 1821).

However, where there is recognition, there exists misrecognition. Within this paper, the terms "misrecognition," "lack of recognition," or "negative recognition" are used to indicate experiences or discussions in which the interactions between individuals do not describe inclusion or those experiences that do not bestow value to those involved (Schweiger, 2019). Interestingly, the German philosopher George W. F. Hegel broadly discussed recognition through misrecognition. He examined the experience of social exclusion and social isolation to identify how these things lead to not only innate mental and psychological reactions but also how exclusion and isolation from one's surrounding peers and community impacted an individual's ability to foster the societal connections necessary to obtain the basics of an education which could impact one's ability for a prosperous livelihood (Hegel, 1807, 1821). This indicates how recognition and misrecognition exist in an institutional social binding arrangement in which some are seen as belonging and granted full access to the opportunities of the institution, and others are denied these

privileges with the additional damage to their mental, emotional, and social well-being (Fraser, 2006).

Methods

Participants and Data Collection

Prior to recruitment, the research proposal, consent form, interview guide, and recruitment instruments were submitted and approved by the university's Institutional Review Board (IRB). Participants in this study included 15 undergraduate students. Eleven students identified as African-American and members of the Black Diaspora, and four were native or direct descendants of an African country. Students identified as sophomores or higher (six sophomores, five juniors, and four seniors). Though the recruitment was broadly shared within the College of Engineering, all participants were BME majors except one biochemistry major. All fifteen students identified as female except one student who identified as non-binary. Five students transferred from an HBCU (Historically Black College or University) through the university's dual degree engineering program. After the interview, all participants received a $25 Amazon Gift Card as an incentive and compensation for their time.

Students were recruited through course announcements, a digital poster in the department's building, and several student listservs (i.e., mailing lists). Interested students were able to access a Qualtrics link on the recruitment material. Qualified students were contacted via email, providing more information about the study, a contact person for questions, and a calendar link to schedule an interview. The first round of interviews (7) was conducted in the summer of 2022. The remaining eight students were interviewed in November 2022. Students were offered in-person or virtual interview formats. All but one interview was conducted virtually. The students were encouraged to turn on their cameras for virtual interviews to facilitate efficient communication

between the participant and interviewer. The average interview time was 45 minutes, ranging between 27-63 minutes. Due to confidentiality and to ensure the anonymity of the participants, each participant was assigned a code of "Student" and a sequential number (i.e., Student 1) instead of a pseudonym. Assigning a pseudonym involves removing one type of identity and replacing it with another one that may not be aligned with the participant's identity and may change how the readers interpret and mentally identify the students (Heaton, 2021).

Data Analysis and Code Development

First Phase Coding

The researchers employed a two-phase qualitative content analysis. A qualitative content analysis provided a structured framework to organize and examine the data for meaning (Hsieh & Shannon, 2005). The first phase of the analysis employed an inductive approach guided by values and process coding to disassemble the data, examine the interviewees' connections to each other, and search for initial patterns. The process coding was used to identify the students' reactions and responses regarding their classroom and campus experiences (Saldaña, 2013). The values coding approach highlighted the student's values, attitudes, and beliefs in these situations (Saldaña, 2013).

Second Phase Coding and Deductive Analysis

After examining the first coding phase, the researchers performed a more focused deductive qualitative content analysis. A deductive content analysis provided a systematic and objective approach to draw replicable and valid inferences of the data from within its context (Krippendorff, 1980) and brought awareness to important concepts as they arose within the data (Gilgun, 2019).

We drew from several theories of recognition within the social sciences to develop the codebook for the deductive analysis. The initial codebook considered the primary theories and

discussions identifying the actions and interactions that shape and identify recognition. The initial codebook contained thirty-one codes identifying various aspects of recognition and misrecognition. By disassembling and reassembling the data sets, we identified how the experience of misrecognition and experiences lacking recognition were present within the students' experience and likewise absent within the research.

As specified earlier, this study focuses on identifying and describing experiences of misrecognition. For this purpose, this paper discusses the three primary categories identifying misrecognition: 1. disregard for a student's achievement and contribution, 2. disregard for a student's cultural distinctiveness, and 3. exclusion as an equal partner within various relationships and interactions.   Each code category was developed from an analysis of pertinent theories of recognition (Table 1). For example, Taylor (1994) discusses the importance of acknowledging another's cultural attributes and characteristics as an essential part of recognizing a person individually and socially. This formed the code to identify experiences when a student's specific culture was respectfully acknowledged or negatively dismissed. Another important identifiable recognition component occurs when one person's s acknowledges another's contribution in an interaction or social setting. In Tully's (2000) work regarding recognition and distributive forms of justice, he emphasizes how when one person acknowledges another's attempt to contribute to the group, a sense of belonging and a connection to the community develops. However, suppose the other members of the community ignore one's contribution. In that case, they are not recognized as a community member and experience exclusion and adverse effects on self-esteem and their sense of belonging. Lastly is the concept of exclusion. An exclusionary act implies that a person is not of equal standing as others (Laustsen et al., 2017a). Exclusion refers to a person

being ignored or slighted for the socially accepted forms of participation shared among the entire community (Honneth, 1995).

Table 1

Theoretical References for Codebook Development

Primary Code	Theoretical Reference
Disregard of one's contribution	Honneth, 1995, 2006
Acknowledgement of one's contribution	Tully, 2000
Experiencing disregard for one's cultural distinctiveness	Lausten et al, 2017 O'Neill & Walsh, 2009
Experiencing acceptance of one's cultural distinctiveness	Taylor, 1994
Experiences of Exclusion	Fraser, 2001, 2008
Experiences of Inclusion	Honneth, 1995

These codes were then examined and drafted to reflect the duality of recognition: the positive experience of being seen and the negative experience of not being recognized (missed opportunities for recognition) or misrecognition (experiencing a form of recognition with a negative impact upon a sense of belonging and identity). A pattern emerged in which the codes that characterized misrecognition and a lack of recognition became heavily coded versus positive recognition experiences. This pointed toward an interpretation identifying how the referenced literature within this study did not discuss experiences of assessing experiences in which students did not receive recognition or were misrecognized. Additionally, this analysis provided examples of the interactions that portray misrecognition and how students felt and responded to these situations.

Trustworthiness

Mechanisms of reflexivity and reflection were constantly situated within the research project to establish a rigorous research study. The data was systematically checked for biases throughout the study. Additionally, the primary research team discussed the codebook, the initial coding, and the categorical development throughout the study.

Our primary approach to verifying the trustworthiness of our data was through the statistical analysis of co-coding. All coding was conducted using the qualitative coding software Dedoose. After multiple conversations of the initial coding with the primary team, an undergraduate BME student research assistant aided the co-coding process. Two rounds of testing occurred in which the primary researcher created tests for each code, and the student completed the tests, and then the student created tests for the primary researcher to complete.

The co-coders' reliability was verified with Cohen's Kappa coefficient, κ, to measure the agreement between the two raters. Kappa is best applied in projects where two raters judge and code the same material (McHugh, 2012). A weakness of the Kappa statistic is that the strength assignment to the result is arbitrary. For example, Landis and Koch (1977) designated a κ between 0.40 and 0.59 as "fair." However, another study rated their rate of a fair agreement with a κ between 0.21-0.40 (Brennan & Hays, 1992).

Drawing from multiple research studies regarding Cohen's Kappa coefficient, the researchers agreed that anything less than 0.40 (fair) necessitated a conversation to discuss the significant difference between the two raters. This conversation resulted in either a correction of the coding excerpt, a discussion of the specific code and its definition, or a resolution of the difference between the codes. Additionally, having an undergraduate BME student on the team offered the more senior researchers, who had been out of their undergraduate programs for several years, valuable insights and perspectives on the current undergraduate experience.

Researcher Positionality

The authors of this study were aware that our social identities informed the design and analysis of this study (Cresswell, 2014). Only one of the primary authors was involved with the initial culture and climate study. However, all three authors were involved in developing the qualitative study that drives this paper. In addition to the three primary authors, the team included an undergraduate research assistant to assist with the co-coding process. During the analysis, the student was a senior biomedical engineering student. The team consisted of two women and two men; two identified as BIPOC and two as white. Two had a disciplinary background in engineering, one in developmental psychology, and one in Science and Technology Studies (STS). The four-person research team reflected on their academic and personal positionality and its potential impact on the study. The primary researcher identified as a Bi-racial woman and a first-generation student with a Science and Technology Studies (STS) background. The second researcher identified as a white man with a chemical and biochemical engineering background and engineering education. The third researcher identified as a white female learning scientist with a background in inclusive pedagogy. The fourth researcher identified as an Asian American male.

Results and Findings

Recognition is a critical component of engineering students developing engineering identity. The research literature has focused on recognition and its connection to engineering identity within the graduate student population (Bahnson et al., 2021; Choe & Borrego, 2019), LatinX students (Kendall, Denton, et al., 2019; Rodriquez et al., 2017), and quantifying recognition as a measurement tool (Godwin, 2016; Li et al., 2021). Most of these scholars discussed the importance of peer recognition within traditional classroom interactions, thus

emphasizing the significance of engineering identity formation being dependent upon shared peer interactions and recognition typically found in the classroom.

Acts of Exclusion

One of the prevalent forms of negative recognition was acts of exclusion. Exclusion among peers, professors, and others within the BME department was articulated by all fifteen participants and was coded thirty-one times in the interview data. Exclusion is a form of negative recognition or misrecognition that occurs when an individual is not allowed to participate in the fundamental rights and opportunities of the community (Laustsen et al., 2017a). This denial of participation or presence sends the subtle message that the person is not an equal partner (Honneth, 1995). We drew from these readings of recognition and exclusion to identify and understand these experiences. Examples of exclusion were articulated by students not being paired up, needing help locating classmates for in-class assignments (Student 6), or other students not sitting with them in the classroom setting, as shared by Student 3. Sometimes, the exclusion is not as apparent and manifests subtly, making one feel isolated and alone (Student 11).

Student 6: In other classes when they tell us to like pair up, sometimes I wouldn't get paired up; I don't know if it's because I stink or what. It was sad. That was early on in my experience.

Student 3: [describing another student's experience]: So she's also an African-American female. And she's talking about her PSS (problem-solving studio) experience. She said she'd be the first person to get to the classroom. She's sitting at a table of four, so there's three [other] seats. And she said not only would people choose not to sit next to her, but they would also take chairs from her table of four and add it to an already full table of four and make a table of five, six, seven, and eight. She joked about it…do I have the

plague…am I that gross that y'all don't want to sit down next to me? It's a very ostracizing experience. I haven't had that experience. But mainly it's because I come a little bit later so I'm joining another table.

Student 11: I feel like there might be subconscious biases, things that are just underneath the surface in a way, just like interactions and just like, generally, not seeing as many students who share the identities, the same identity that I do. And I feel, at times, I don't have enough people that I share an identity with. I feel like it's pretty evident in some of my classes or a lot of BME classes are very group-heavy or group-dictated.

Disregard of One's Contribution

Disregard of contribution described students' experiences of attempting to participate, yet these acts of participation are ignored. For example, a student may offer a suggestion for a group project. However, instead of someone in the group acknowledging their suggestion, they do not receive any acknowledgment of their contribution. This form of misrecognition is highly damaging because an attribute of recognition occurs when a person's work and contributions are acknowledged or accepted by their community (Honneth & Wright, 1995). A disregard of contribution denies a student's social acceptance and ability to verify their engineering knowledge (competency and performance). Thus, disregarding a student's contribution hinders their engineering identity formation. Furthermore, this type of behavior, described by scholars as a "denial of recognition," restricts one's desire and ability to participate and introduces doubt into their development (Honneth, 2006).

For example, Student 9 described an experience in which she felt that her contributions to a group project were ignored:

It was just very disheartening that I'm trying to contribute to completing the lab as a group. And they would either try to work on the lab by themselves and ignore me completely.

Student 10 described another experience of attempting to contribute to the class discussion and being ignored and overlooked:

One time, my TA was asking for the equation. I had memorized it, so I said it. He looked at me, and I knew that he heard me. But as soon as another student said it, I'm not sure if it's relevant, but a White student, he took it immediately and wrote it on the board. And I felt like being second guessed, even when you're confident it's right, is a little bit challenging.

Student 2 described a similar experience of how not "looking" the part made her feel overlooked.

Student 2: I feel like in classes, sometimes when you offer an idea or you offer insight that seems like important or it's significant…if you don't look like the person to give that answer, the right person to give that answer…it's overlooked. It's overshadowed. It's like you're not contributing to the greater conversation. But then if someone else says something literally just like what you said or says something along the lines of it, it's like, oh, my goodness, that was world renowned.

Interviewer: And has that happened to you?

Student 2: Definitely.

In these experiences, the students describe how other students or instructors ignore their participation attempts. Student 10's experience is unique because it exemplifies the student's inability to verify their engineering knowledge and competency and creates doubt in their ability.

Disregard of cultural distinctiveness

Another important aspect of recognition is how a person's cultural distinctiveness is either seen or ignored (Honneth, 2006; Laustsen et al., 2017b). When a person's unique culture is ignored or belittled, it affects their desire to participate and seek recognition (Fraser, 2001, 2008). Recognition celebrates cultural differences and welcomes individuals into the community (O'Neill & Walsh, 2009). Students sharing experiences in which they felt a disregard for their cultural distinctiveness were coded twenty-two times within the data.

This third category expands the idea that recognition, or a lack of recognition, is a personal experience (Student 13) and a collective experience (Student 11). Student 13 noted that she had not felt that she made connections with the other students and, upon further discussion, connected it to her identity as an international student and being the only Black student.

Interviewer: Okay. Taking all these things into consideration, so when you're in the classroom setting, what is that experience like?

Student 13: What do you mean by what is my experience like?

Interviewer: Do you have people that you connect with in your classes, other students?

Student 13: What do you mean by connect? Connect means different things. In terms of what exactly?

Interviewer: Over working together. Collaborating.

Student 13: Honestly, I think I haven't connected with anyone because now that I think about it, I have been always the only international student and the only Black student. Not the only female, which I'm very grateful for.

Interviewer: Do you think that is because of your background?

Student 13: Yes, because they don't get my struggles, but I kind of understand their struggles. You know what I mean?

This created a one-sided experience because though she understood their struggles, the other non-Black students did not understand how her experience as a Black international student affected her experience in the program. This experience exemplifies how recognition or lack of recognition is framed and defined through a mutual understanding of others' different cultural characteristics (Honneth, 1995; Laustsen et al., 2017a). However, this mutual understanding is sometimes inaccurate and hurtful, leading to misrecognition. The following student experiences revealed how our student participants are not seen as individuals but as collective stereotypes.

Student 11 described how the data and reference points used in class projects that referenced and focused on the harmful inequalities affecting those who identify as Black have led to students assuming similar qualities about her and her family.

Student 11: Being an African American female, I am the only one in many of my classes. When we were doing projects, researching Black demographics, and how COVID-19 affects the Black demographic… I am seeing all of these presentations, and I'm like okay, well, why are all of our users Black, you know, like not other demographics. And then it's kind of like people [students] have looked at me and asked, well, do you have any experiences? And do you want me to sit here and say my grandma had COVID because she's Black, right?

Student 6 described a class project to develop a medical device to examine stress and how one group developed a product narrative evoking negative perceptions of absentee fathers within Black communities:

Group number six decided that their narrative will center around a Black man named Akon, who has baby mama drama and, therefore, is stressed. And I just thought that that was so incredibly insensitive. It just seemed like they put Black people in this box and had this one view of what African Americans are…it was disappointing that they had such a narrow opinion, and it was just so stereotypical.

Discussion

This study highlighted negative recognition by theoretically defining the concept and providing a language and framework. Much of the current research has focused on framing recognition as when one is seen and the extent to which they are seen as engineers by themselves and others in their proximity. However, our research highlighted the importance of reconsidering engineering identity recognition within experiences of negative recognition. Misrecognition and negative recognition are critical when studying recognition in engineering education. Two critical studies highlight this point. The first showed that female engineering students received little recognition despite high competency, contributing to their weaker engineering identities and a diminished sense of belonging (Tonso, 2006). The second study showed that women in the sciences faced challenges due to needing recognition from their professors and superiors (Carlone & Johnson, 2007). Though these studies discuss the challenges at the intersection of engineering identity recognition and underrepresentation, very few studies have purposely designed studies focused on negative recognition.

The initial focus of our discussion centers on the settings in which these experiences occurred. Most occurred within the classrooms, among peers who did not identify as Black or African. Departmental statistics confirm that our student participants are in the minority in these settings. Though more than half of the undergraduate BME students are women (59%), only

twenty-five percent of the department's students identify as a minority (O'Connell & Stern, 2023). From the university perspective, about 7.7% of the Fall 2022 undergraduate student body identified as Black or African American (*Student Demographics | Institutional Research & Planning*, n.d.). Student 11 commented earlier in this paper that she was the only African-American student in many classes. Yet, these experiences are not limited within the classroom but were also experienced on campus as described by Student 6:

> We've experienced that as black people at XYZ University in general. Those microaggressions of something as simple…well I guess it's not simple…assuming our major and assuming that we're not engineers at a predominantly engineering school. Or even that we don't even go here when we're on campus. It's kind of like, 'Oh are you visiting? Are you someone else's friend? Are you from [another university in the area]?'

> This is important to consider as the classroom is the primary point in which students will interact with other students, be introduced to the concepts that will foster their competency, and be able to perform what they have learned to build their sense of belonging and engineering identity. The classroom is a crucial aspect of a student's academic life not only because of the time they spend there but also because of the people with whom they spend this time. A classroom's social and cultural composition impacts how students interact and learn, fosters possibly unmalleable roles and status among themselves, and shapes their future experiences within their academic and professional futures (Turner, 2017). However, moments of misrecognition create barriers to both their academic and professional outlook. Within the classroom, instructors can observe student exclusion or isolation occurrences. For example, suppose a professor or TA notices that a few students struggle to locate study partners or are sitting alone. In that case, the professor can create teams or be aware of creating a physical arrangement

that is socially and physically inclusive. Additionally, instructors could train the class in effective communication techniques. Such training could include learning activities that promote active listening, awareness of one's nonverbal communication, or educating students on healthy communication feedback loops.

A second point of discussion is how this impacts the student's ability to foster relationships with their peers that will facilitate their entrance and sustainability in their studies and within the profession. Another related finding of this study is how misrecognition impacts one's ability to form relationships within the classroom and the engineering community.   This barrier to developing relationships with their BME community was articulated within 32 experiences, with 22 of these experiences connected to the student's ethnicity (Table 2).   It dramatically impacts students' ability to foster a sense of belonging if they cannot foster respectful communication among their peers. Multiple studies have demonstrated how students from underrepresented and underserved backgrounds face many challenges in fostering a sense of belonging within STEM and education (Ito & McPherson, 2018; Rattan et al., 2018; Walton & Cohen, 2007; Willms, 2003).

Table 2

Coding of reasons student-participants were not able to develop relationships.

Note: The 32 reflects the students' articulated experiences. Some students described multiple experiences. Also, one experience may have been connected to multiple reasons, such as ethnicity and gender.

These experiences not only impact the student's engineering formation but also have very personal impacts on the student's psyche and interpretations of themselves. An additional coding of the student's feelings indicated negative associations with these experiences. Table 3 displays the experiences in which students vocalized an emotion about being excluded, having their

contribution ignored, or experiencing a neglectful response or behavior toward their cultural uniqueness.

Table 3

Students Articulated Feelings to Misrecognition Experience

Explicit Counts of Expressed Feelings	Expressed Feelings toward Experiences of Misrecognition/Exclusion
11	Annoyed
5	Empathetic
17	Estrangement
10	Frustrated
15	Invisible
5	Lonely

Note: This table only denotes the actual articulation of the student's feelings. We did not code an indication or deduction of feeling.

Conclusion

For many researchers, engineering education recognition has been approached from being seen by others as an engineer or one's self-perception of oneself as an engineer. Regarding recognition, this has been a good place to start and has made invaluable contributions to this field of research.

However, the repeated examination of assessing recognition has overlooked the opportunities to understand the experiences of when a student does not receive recognition and instead experiences negative recognition as defined within this piece as exclusion, a disregard of contribution, and an indifference to cultural differences. In short, as researchers, our current focus

on recognition means that we have only partially studied engineering identity recognition. Ironically, the issue of misrecognition often goes unnoticed because the initial tends to be on recognition itself (Schiff, 2014). Nevertheless, highlighting misrecognition within engineering education is one step toward remedying our previous work, contributing to the topic of engineering identity, and fostering more inclusive classrooms and equity in engineering.

Addressing misrecognition within the classroom and engineering education is an enormous feat. From a cultural and social point of view, institutional level recognition has been reinforced through decades of the dominant group repeating and reinforcing a specific image and ideal of who belongs within a community at the detriment of maintaining an inferior comparison for those that do not fit the criteria (Taylor et al., 1994). For example, an engineer is typically associated with a white male with a penchant for math, science, and analytical thinking. Over decades of reinforcement, this image has become engrained within our national and individual psyche. Therefore, it will take years for what is recognized as an engineer to change. Though this can feel daunting, it is occurring through national and local campaigns to change the face of engineering to include a variety of identities.

Furthermore, misrecognition can be challenging to address because it is not comprised of direct outward actions or force that can be readily and immediately addressed. Often, these experiences are symbolic in which the misrecognized individual eventually relents (Bourdieu & Wacquant, 1992). In closing, as Student 2 shared,

> I think when I try to contribute, because of who I am, and my identity, and how I appear, it can come off as like aggressive. If I voice this, it will either, one, make them see me worse than they already do, or not be heard. And I feel like being unheard twice would definitely make me feel terrible and lonely."

Misrecognition is not benign. Instead, these moments of exclusion and disregard have lasting impacts upon our students and within the field.

Limitations

It is important to consider that this research is based on a small sample of students from one engineering program and does not represent a random sample of any population. Additionally, our population all identified as Black or African American and female, with one student identifying as non-binary. It is important to note that this study's race and ethnicity limitations were purposeful as this study was designed in response to the significantly negative responses of students who identified as Black in a previous departmental climate study.

Regarding the gender demographics, the recruitment tools invited any student within the College of Engineering who identified as Black or African American regardless of gender, ethnicity, sexual orientation, or other factors. However, the two male students who completed the initial interest surveys did not reply to our follow-up emails. Yet, the gender demographics are not unusual for this engineering field. Most biomedical engineering programs tend to enroll more female students than other engineering majors. Though gender was a consideration within this study, most of our participants connected their experiences to their ethnicity and race. Therefore, this study focused on the identity of being Black and in an engineering program. This study did not consider the other numerous aspects of these students' identity, such as socioeconomic status, international/immigrant status, and first-generation designation. However, these personal identifiers are potential variables for future studies.

Additionally, all but one student majored in biomedical engineering. The researchers shared the recruitment materials multiple times within the College of Engineering. However, this

limitation could be connected to the study's researchers' affiliation with the biomedical engineering department.

Additionally, this study was limited to the students' experience at a Primarily White Institution (PWI). This environment dramatically shapes their experiences of misrecognition. Future studies could explore engineering identity misrecognition at an HBCU or minority-serving institution.

Though this study was limited to undergraduate students who identify as Black, female, and non-binary, the results from this study can be used for future research studies regarding other ethnic and cultural-specific populations to explore similarities or to explore other descriptions and experiences of recognition. Additionally, our findings could contribute to an exploration focused on the specific findings of our study. For example, a study could focus solely on the experience of exclusion or disregard of students' contributions. Another study could focus on the impact of these factors. Also, these findings could contribute to a survey assessment. Instead of assessing the student's self-perception of being seen as an engineer, a study could assess the extent of exclusion.

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Footnotes